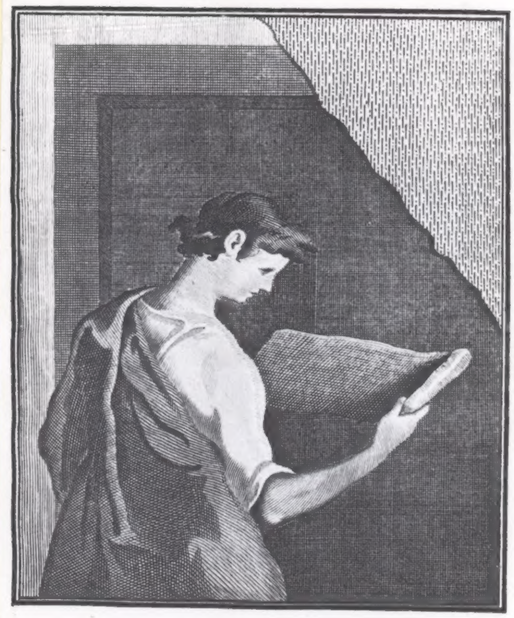

Royal Institute of British Architects.

INCORPORATED IN THE SEVENTH YEAR OF WILLIAM IV.

THE TRANSACTIONS.

SESSION 1883-84.

USUI CIVIUM, DECORI URBIUM.

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ILLUSTRATIONS.

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Royal Institute of British Architects.

INCORPORATED IN THE SEVENTH YEAR OF WILLIAM IV.

SESSION 1883-84.

I. THE OPENING ADDRESS. By Horace Jones, *President.*

[Read on Monday, 5th November 1883.]

GENTLEMEN AND FELLOW MEMBERS,—The losses we have sustained, since the opening Meeting of last November, are no less than twenty-two. Among the foremost is the Viennese master, one of the recipients of the Gold Medal given by Her Gracious Majesty the Queen on the recommendation of the general body of Fellows, the Baron von Ferstel, who died on the 14th July last, after a long and painful illness, at the comparatively early age of fifty-five. Three other Hon. & Corr. Members have also died, viz., Professor de Fabris, architect, of Florence, for some time President of the Royal Academy of Fine Arts in that great city; Christian Hansen, of Copenhagen, a brother of Theophilos von Hansen of Vienna, *Hon. & Corr. Member;* and the Count Vespignani, Architect to St. Peter's at Rome. Though, in this country, as if to afford a contrast to the events of 1881, death seems to have spared the elders, a more than usual number of young professional men have fallen. Four Honorary Associates have also succumbed, viz. W. G. Harrison, the well-known and highly esteemed Queen's Counsel; J. Gascoigne Lynde, of Manchester; Sir Edward H. Scott, the Banker; and William Spottiswoode, who as President of the Royal Society held a position of special honour. His loss cannot fail to be felt by a larger circle than his own personal friends, and it is a mournful gratification to know that, as in the case of the late Mr. Street, a fitting resting place has been found for the remains of the late President of the Royal Society among the highest worthies of the nation, in Westminster Abbey.

The opening in state of the Royal Courts of Justice on the 4th December last by the Queen, with a befitting ceremony including a Deputation and Address from the whole body of the workmen who were employed upon the works, is an important event of the year. I have often noticed in the reports given at various times by the public journals of laying foundation stones, and also at the completion of public buildings, when a royal or other dedication takes place, the names of the architects are generally omitted, and the buildings might have been raised by the touch of some fairy wand as far as regarded any allusion to the hands, hearts or heads of those who had laboured for perhaps years over them. It is therefore an act, in accordance with the kindly spirit of Her Majesty, to graciously express her pleasure at the loyal address presented by the workmen of the various crafts employed upon the building and to congratulate them upon the successful results of their honourable toil.

The opening of other Royal Courts of Justice will soon take place, namely the Palace of Justice at Brussels, and I remark with feelings of some regret that the British do not emulate the Continental peoples in their willingness to bear the expense of liberal contributions for public buildings and national monuments. Let us reflect that Belgium, a country not much

more populous than the English Metropolis, and Brussels, less populous than some of the London parishes, has readily found treble the amount for a palace of Justice that the English have. Had the same liberal scale been applied to those Royal Courts opened in December last, I feel sure that many unkind criticisms of the edifice would have been changed into pœans of praise and admiration.

Last year I touched upon the question of the safety from fire of Public Edifices, theatres more especially. One chief source of danger is the use of doors opening only one way, which when clogged or subjected to pressure by a number of people pushing against them, thus preventing their being opened, are often the cause of a serious catastrophe. Doors intended merely to shut-off divisions might be made to open both ways upon spring hinges, or where, on account of draught, &c., they can only be made to open one way, such as in passages, stairs, &c., they might be framed with an inner stile and rail to open in an emergency the contrary way to that which they generally do. Such a system is particularly applicable to the iron fire-resisting doors, separating one section of a building from another.

I have now to mention the proposed completion of Blackfriars Bridge and the desire of the Corporation of London to adorn the four pedestals or piers at each end of the bridge with ornamental sculpture. In July 1880, the matter was referred to the Bridge House Committee for the purpose of obtaining designs for the proposed work, which in due course were produced. The Committee availed themselves of the courteous advice and the high talent of Sir Frederic Leighton, President of the Royal Academy, William Calder Marshall, R.A., and George Frederick Watts, R.A., who had considered the various works sent in competition, and reported their opinion thereon to the Committee. I had the honour of being associated with them, and unfortunately we were compelled to report that among the various designs recommended for premiums none were adapted for execution—a decision which was endorsed by the Bridge House Committee and approved by the Corporation. At the end of 1881 the matter was again referred to the Committee to proceed further, when they conferred with the same gentlemen, who gave a unanimous opinion as to a certain mode of procedure, but one which involved considerable alteration to the pedestals of the bridge. To that opinion, for various reasons, the members of the Committee objected, and they came to the conclusion to leave the piers or pedestals unreduced in size; in fact, to follow the original suggestion of Mr. Cubitt, the architect of the bridge, as to an equestrian statue; and further, to obtain, if possible, the cast of an equestrian statue, whereby an opportunity would be afforded of appreciating the size and judging the effect of the same upon one of the pedestals of the bridge. An equestrian statue has been suggested, representing a gallant soldier or commander, of royal or of noble race, of the sixteenth century; and I hope that in a short time this model will be placed in position; though, indeed, it is quite understood by the Committee that there are many points in such a work which will have to be altered or avoided in any production or design intended to be permanently put up, and the model is not intended to be any indication of the proposed treatment or subject other than as regards general effect.

Let me now allude to the proposed communication across the Thames below London Bridge. In the first place with regard to communication by ferries. Appropriate in less crowded streams than the Thames, and where the tide is less strong, ferries, nevertheless, have been, and continue to be, and will continue to be, useful means of communication between opposite

banks of great rivers, and in the Thames they will serve more as an indication of what the intercourse between the two shores consists, than as a permanent substitute for other modes of communication. Perhaps their real benefit is to show the approximate necessity or obligation of forming a substantial communication. Secondly, with regard to high-level bridges, it has been clearly shown to be probable that people would just as soon make a round or circuit as mount a considerable height only to descend again; that the actual distance to be travelled, whether by mounting and descending or taking the round of London Bridge, would not be very different in going to or from the East end of London and the Elephant and Castle, Kennington Gate, &c.; and it has also been clearly demonstrated that a tunnel would require the same length and the same gradients as a high level bridge, only that of course they would be reversed. Both these methods are considered by their principal supporters to be considerably ameliorated by the ample means of giant lifts and other machinery worked either by hydraulic or steam power, but there are some who look less kindly on such appliances. Thirdly, a low-level bridge, which, in respect to the land traffic, is of course unexceptionally the most economical, means, as regards the river traffic which is really many times greater than the land traffic, absolute annihilation, as far as sea-going vessels are concerned, west of any such proposed bridge, though the nearer it is placed to London Bridge the less serious will be such annihilation. A low-level bridge with openings will not cost more than one-third of the others, and if the waterway be left open, with occasional closures for, say, two or three hours during each tide, that will be the maximum interference with the river traffic. At night the opening of the bridge at high water would be continual.

Various statistics have been taken but none which absolutely show the exact number of vehicles passing, say, from the north end of the Minories and more distant points to, say, Tooley Street or Bermondsey Street. From these statistics of vehicular and pedestrian traffic, the one taken on 3rd July 1876 shows that about 99 is the number of vehicles that pass in this direction and about 156 in the direction of Bricklayers' Arms and Old Kent Road, but the gain to these latter would be very slight, even were there any other communication on either the east or west side of the Tower. Therefore it may be assumed that there are not more than about 260 vehicles for which this bridge is to be made. If, however, they doubled the number, and made it, say, 500 each way, that would be a very liberal if not an extravagant estimate of the present position of the traffic. It has been assumed by Sir Joseph Bazalgette and Colonel Haywood, and many others who have considered the question, that that traffic will very quickly rise to between 4000 and 5000 per diem, but it must be kept in mind that public money should only be spent in the improvement of present thoroughfares, trade, &c., and that to spend money for the future and speculative improvement of any district is not to improve the interests of the added number of the inhabitants, because they are not yet there, but only to improve the value of the landowners' property. The cost of the future improvement of special trades or commerce, as common political economy most plainly indicates, should be borne by individuals; and not by the public, any more than the public should pay the expense of new roads, sewers, railings, &c., of agricultural or waste land, in order to permit the freeholder to reap the advantage of it as land ready and laid out for building purposes.

In regard to a high-level bridge it has been already demonstrated that a height sufficient to leave the river traffic uninterrupted would render the bridge utterly useless on account of

the length of the ascents and descents. Lifts, say 70 or 80 feet high, may mitigate this to some extent, but would of themselves be an unsatisfactory solution of the problem. Then, as to cost, Sir Joseph Bazalgette estimated the cost of a high-level bridge at between two and three millions. A tunnel would be equally inconvenient, incur much the same expense, and, without lifts would be equally useless. One scheme, devized by private enterprise last year, was lost before parliament. It had, however, the inconvenience or convenience, as the case may be viewed, of twelve lifts, six on either shore, and the estimate appeared to promise some considerable economy.

A temporary steam ferry has been estimated at from £10,000. to £20,000. per annum, and if one could be established for a year or two at £14,000. or £15,000. per annum, it would demonstrate the propriety or non-propriety of expending a capital sum the annual interest of which would be equal to £30,000. per annum at the lowest, and under certain circumstances up to £120,000. or even more.

A low-level bridge appears now to be the only matter to be dealt with. First let us take that which will be most convenient for land traffic, viz. an uninterrupted one. The nearer it is to London Bridge, the less damage will it do to the river traffic. One has been designed, keeping very nearly on a level with Fenchurch Street, the upper floor of Billingsgate Market, the departure platform of the London and Brighton Railway, London Bridge, and running again into High Street, Southwark. The cost of that will be considerable, probably approaching two millions, and it will receive serious opposition from the owners of Fresh Wharf. The one proposed to be erected upon the site east or west of the Tower will cost, if continuous, about half a million of money, but it will be the ruin and annihilation of all the wharves westward of it to London Bridge, including Billingsgate, and it will be pursuing a diametrically opposite course to that pursued by Manchester and other important commercial centres, viz.: bringing seagoing ships as near the heart of their trade as possible. It will interfere with and stop the reception of thirty or forty millions per annum which would be gladly welcomed by the wharves at Ratcliffe, Limehouse, Blackwall, down to Gravesend, as also by the Docks which have been and are still being made; for when a trade is once displaced it may seek other and more distant localities. To obviate that—a serious and imperative objection—a low-level bridge must be made with openings readily worked and thoroughly adapted to passing an average of about twenty seagoing steamers to and fro per diem (say, ten each way each tide). The present line of berthing ships gives a clear space of, say, 300 feet, and if that, or even, if desired or deemed necessary, a few feet more, be given, no more inconvenience need arise than exists now in passing the line of boats and ships berthed as at present. If that 300 feet space be maintained and the bridge kept open at high water, at a slight inconvenience to the land traffic, no complaint of obstruction could be made as to the river traffic. Such a low-level bridge can be constructed either as a swing or lever bridge, or a bascule or lifting bridge, designs for all of which have already been before the Corporation and the public. One proposal made by an eminent engineer is to put a pivot bridge in the middle of the stream: that appears to be a mistake as it reduces the maximum of the opening to only about 180 feet clear of the berthing line of barges, &c.

HORACE JONES.

II. FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS.

By Edward Cookworthy Robins, F.S.A., *Fellow.*

[Read on Monday, 19th November 1883, Ewan Christian, *Vice-President*, in the Chair.]

THE title of my Paper sufficiently indicates its supplemental character. Last session I had the honour of introducing to the notice of the profession a series of very interesting English and foreign buildings erected for applied science and art instruction, but only incidental reference could be made in that Paper* to the fittings of the various buildings therein described. The subject of the general arrangement of rooms, and their relation to each other and the several departments, was more than sufficient to occupy your attention for one evening, and the space available in the Transactions was obviously limited. In yielding to the request of the Council that I should complete the subject by a more particular description of the fittings required for their effective use, I am the more willing to do so because it is of the utmost importance in a truly economic aspect of the question that the architect should possess, from the very outset, a clear preconception of the structural provisions involved in the adoption of the particular system of fittings intended; and I must here premise that it is not, I venture to think, to the interest of promoters of buildings for science instruction to ignore the valuable suggestions of the men who will have to impart the instruction for which the whole expenditure is made, nor to treat as mere "whims" the practical outcome of their careful study and comparison of the best means and appliances available.

In my anniversary Address to the Sanitary Institute of Great Britain in 1882, I endeavoured to make clear that there was a work of research to be done by the teachers of pure science which architects could not be expected to include in the numberless subjects already engaging their attention and absorbing their energies, which nevertheless their constructive faculties and powers of adaptive design were best calculated to utilize for the benefit of the community when once they had grasped the scientific principle involved. Since then I have seen the Address of Professor Stuart of Cambridge, at the inaugural meeting of the Dundee University, wherein, under the head of "Modern demand for Technical Instruction," he says:—"But now we have come to a time when there is again a great change in human "knowledge. The material part of human life calls for its scientific treatment, and is capable "of it.† This is the age of a new University movement, which, in all directions, is manifesting

* See the Transactions, 1882-83, pp. 81-100.

† The Universities of Germany, through the influence of Liebig, have long since taken the lead in the culture of the natural sciences. The Polytechnics supplement them, but consequent upon this breadth in University teaching referred to by Professor Stuart, and the increasing honour paid to the study of science and its applications to various industries, added to the greater prestige attaching to University degrees, the Polytechnics no longer present such exceptional advantages, and in all probability they will eventually be absorbed by the Universities to make room for a new class of technical institution of lower grade, which event it would be wise for us to anticipate.—E. C. R.

"itself either by additions to existing Universities or by the foundation of new ones. The "buildings of the past are only the quarry, and not the model for the new buildings you "are to erect."

PHYSICAL LABORATORIES.

The great desideratum of a physical laboratory is a steady working table,* and this is difficult to secure. Stone brackets and stone or slate tables built into the walls, with and without stone brackets underneath, are common; and solid piers, brought up from the basement to about 3 feet from the floor, are also quite usual; but Professor Ayrton incloses certain of the tables on these solid bases, distinct from the general flooring, in glass cases as working-benches, the window having rising sashes, which can be raised while working, but closed, locked and kept free from dust and meddlesome fingers at other times. He also designed for Japan a students' gallery for the lecture-room, in which solid piers from below were carried up to sustain the working-benches at the different levels of gallery staging, making it possible for the students to repeat the professor's experiments without leaving their places; thus the lecture-room became also a laboratory, and was surrounded with cases for the collections of instruments, &c. In every town, however, the solid soil trembles more or less, and the brick piers themselves, even on concrete foundations, vibrate. To overcome this many suggestions have been made: that they should be more deeply founded, and surrounded by an area with or without water filled in, so that the top surface of the ground should not be in contact, and recently, also, a professor has proposed that stout lead should be laid in the joints in place of mortar, and the piers built of stone blocks. Test experiments are being made at South Kensington in reference to this difficult matter.

CHEMICAL LABORATORIES.

In the description and critical analysis of the fittings of Chemical Laboratories, upon which a considerable amount of ingenuity has been displayed, I have been greatly assisted by my friend Professor Armstrong; if, quite unintentionally, I seem to speak dogmatically, it will be due to the results of consultation with him and many other eminent chemists, among whom I should mention Professor Roscoe, Dr. Perkin, Professors Thorpe, Ramsay, Tilden, Carnelly, Clowes, Fisher, McLeod, and Jones, as having given me valuable aid. Messrs. Waterhouse, Clifton, Murgatroyd, Cossins, Eagles, Ireland and Maclaren, and other architects, have furnished me with illustrations of their works.

i.—Working Benches and their Fittings.

(*a*) *Dimensions and distance apart.* The dimensions of the Benches in a Laboratory intended for the ordinary operations of qualitative and quantitative chemical analysis, and the distance between the benches (that is, the width of the gangways) must necessarily depend more or less on the space at disposal. In all the best laboratories they are placed at right angles to the windows in the flank walls [Illustns. i, viii, xiv, fig. 43], and invariably so in Germany.

The chief points to be borne in mind are. 1. *That the bench should be of such a depth that the student can without difficulty reach from front to back, say 2 feet 3 inches.* 2. *That the top of the bench should be at such a height above the floor level that the student standing at the bench can carry out the various ordinary operations of filtering, etc., without raising his elbow much above*

* See the illustrations to a Paper I read at the Society of Arts, in April 1880, on Secondary School Buildings.—E. C. R.

its natural position, say 3 *feet.* 3. *That the benches should be sufficiently far apart to admit of at least one person passing between the students who are working back to back at contiguous benches, say* 4 *feet* 6 *inches to* 5 *feet.*

With reference to the first and second points, it is obvious that, since there is a considerable variation in the length of reach and height of different individuals, only the average requirements in these respects can be met in the case of public laboratories; for these must necessarily accomodate a variety of students. As a rule, it is only in school laboratories that the very special requirements of a particular class of students can be consulted. In institutions where separate rooms are provided for beginners and advanced students, it has been usual to afford greater space to the latter class. As a matter of fact, however, I am informed that the beginner has often to deal with larger apparatus than the advanced student of quantitative analysis. Be this as it may, it is not improbable that in future the work of the beginner and of the advanced student will tend more and more to approximate in character, and to differ rather in the extent and thoroughness with which similar subjects are studied. The architect consequently may not be called upon to perpetuate the system which has hitherto prevailed.

(*b*) *Drawers and cupboards, &c.* The space under the working bench is always fitted with drawers and cupboards, which necessarily vary in number and size. The character of the arrangements commonly met with may be seen at Leipzig, Owen's College, Finsbury College, Dundee University and Manchester Grammar School [Illustns. ii, iii, iv, ix, xv, xvii]. Usually at least two cupboards and two drawers are fitted in the space allotted to each student's use, or a drawer and cupboard may be assigned to each of two students attending at different times. Except in the case of students engaged in research, no other provision is required. A long narrow drawer extending across the entire double bench as at Leipzig and Manchester and the Yorkshire College is of the greatest use to advanced students for storing long tubes, &c. The cupboards are generally fitted with one or at most two shelves, but it is desirable that one or both of them should not extend the whole distance from back to front, in order that tall articles may be put away. Open niches take the place of cupboards in some cases. To minimize the number of locks and keys several devices have been introduced. At Leipzig the two cupboards and two drawers are kept closed by means of a T-shaped piece of brass and a single lock. At the Firth and Finsbury Colleges, the drawer has no lock, but is kept closed, by an oaken spring beneath it, so that only the cupboard doors have to be unlocked and the spring pushed up, which the student does in commencing work. The bottom of the cupboards should be raised a few inches, and space for the fore-part of the foot be thus provided as at the Manchester Grammar School. In some cases the cupboard fronts are themselves set back 4 or 5 inches from the front edge of the bench top.

(*c*) *Materials employed.* Either deal or pitch pine according to the funds at disposal is almost invariably employed for all but the bench top. At the Nottingham University College, American walnut has been largely used.

Considerable diversity is met with in the treatment of the bench top. It need scarcely be stated that the materials employed should be as durable and impervious as possible, having little tendency to absorb liquids, to be stained, or to shrink and crack under the influence of heat radiating from the burners employed in heating flasks, &c. Pine, deal, beech, oak, mahogany, teak, nut and American walnut have been used. The last only at Nottingham, and

nut only at Geneva. Deal is commonly used from economical motives, but it is probable that the economy is more apparent than real. Most tops are oiled only, as required; all woods for bench tops are improved by ironing-in ordinary solid paraffin with a box-iron, or better still a gas iron. Paraffin has the great advantage over oil or wax that it resists the action both of acids and alkalies. Oil and wax are readily affected by alkalies and slowly even by acids. The only objection to paraffin is that it melts under a heated sand bath or when a hot flask is placed on the bench, but a small square of Asbestos cardboard, and a few small squares of carpet or felt supplied to the student meets this difficulty. Of the hard woods above mentioned, teak appears to be the best. Professor Roscoe of Owen's College (where the bench tops are of oak) says that he would prefer teak. The bench tops at the Finsbury College are covered with 7 lbs. lead. Lead is used at Bristol University College; and it is also employed, and highly approved of, in all the numerous laboratories of the Badische Anilin and Soda Fabrik, where some thirty chemists are actively engaged in research and in technical analysis. It is said that lead "blows up" underneath heated objects, and that glass apparatus, &c., in use in chemical laboratories is more easily broken when set down upon it. The former difficulty is easily overcome by the use of Asbestos cardboard, and the latter Dr. Armstrong assures me is entirely imaginary. The best mode of fixing the lead in front is to bend it down over the perfectly square edge of the table top and, after lightly copper nailing it, to fix a rounded fillet of hard wood to the edge of the bench top, bedded in red and white-lead putty, before screwing up. In private laboratories, glass and slate have been used, but these are not suited to average requirements. The edge of the bench top should overhang one or two inches.

(*d*) *Sinks.* It is customary to provide sinks, about 9 inches diameter, in the benches for beginners, as has been the case at Owen's College, the Manchester Grammar School [Illustns. iii, iv] and the Yorkshire College, and they are usually placed so as to be accessible to students on both sides of a double bench, and serviceable to four students. These sinks are in some cases circular, in others oval or oblong. For advanced students the sinks as a rule are placed at the ends of the benches, as at Owen's College. At the Finsbury College there are sinks at each end of the senior students' benches, but no sinks are attached to the benches which are chiefly intended for the use of "occasional students," but a long demonstration table on a raised platform runs at right angles to these benches, and in front of this is a lead-lined sink, 16 feet long by 12 inches wide, and 12 inches deep, with a reservoir under the top of the demonstration table [Illustn. x]; this upper tank is kept filled by the ball tap, and thus the water is delivered from the taps at a constant low pressure, and splashing avoided. In this case the students must leave their places whenever they wish to wash their apparatus, but the distance is short and there is ample accommodation for eight students at the sink. If the sink be on the bench it is difficult to avoid splashing.

Sinks are constructed of various materials—of porcelain, stoneware, enamelled iron, wood, and lead. Stoneware and porcelain are most commonly employed; they are easily kept clean, and if properly glazed will resist chemical action, but they are easily broken both by falling objects and very hot liquids. The best illustration of the use of wood is at Munich, where oval-shaped iron bound oaken tubs are found, made narrower at the top than the bottom to check splashing, and these appear to answer well. Lead sinks do not look so neat as porcelain basins, but they are not so easily damaged; they should, however,

be constructed without the use of solder, and there should be a good fall towards the outlet, otherwise the lead may decay rapidly through corrosion. At the Manchester Grammar School, and at the Yorkshire College, the sinks empty into a V-shaped open drain to outfall.

(*e*) *Re-agent shelves and upper works.* In nearly every laboratory hitherto constructed, a rack of shelves to hold re-agent bottles is placed along the centre of the bench, and is either fixed or moveable, the shelves being about 6 inches wide and 9 inches apart. In some cases a hinged or sliding glazed front is fitted to these racks, as at Owen's College and at Dundee, or revolving shutters are lowered over all, as at Berlin; but this addition is of doubtful utility. In the Medical Schools at Owen's College the shelves are not closed. At Graz two distinct glazed cupboard fronts are provided; one inclosing the bottles for strong acids, and the other the ordinary re-agents; but this is an unnecessary refinement. At Munich only a single shelf is provided for re-agent bottles, and it is carried on iron standards. This arrangement has the advantage that the students on either side of the bench can see each other and converse; to which Professor Williamson, however, distinctly objects. He has so fitted up his new laboratory at University College, London, that each student is isolated as much as possible from his neighbour: a system which does not commend itself to me, and is nowhere else attempted, besides which the professor cannot thus have an uninterrupted view of the students in the entire laboratory as in the former case. At Bristol College the re-agent shelves are moveable. Professor Schmidt, of the Dresden Polytechnic, has his double benches made in three portions. The re-agent shelves (of which there are two besides the top) there form the central division, underneath which are arranged the pipes and wastes, and the benches on either side form the other two divisions. At the Finsbury College a novel plan has been adapted, the large illustration of which will be fully described further on. The re-agent bottles are placed under the " heating shelf " on a raised ledge down the centre of the bench [Illustn. ix].

ii.—Draught Closets for General Use.

Draught closets are closets in which operations can be performed which give rise to the production of noxious fumes or gases. Some provision of this kind appears to have been made from the time of Liebig, the first teacher of chemistry; but the original closets were, in most cases, few in number and of large size, being mainly intended for large operations.

Hofmann first introduced the small closet now so universally met with in chemical laboratories, and recommended by the South Kensington authorities.

(*a*) *Position of draught closets.* The position of the draught closets intended for operations incidental to ordinary qualitative and quantitative analysis, indicated in the Owen's College, the Dundee* and the Yorkshire College plans may be regarded as typical. In both cases the closets are near to the ends of the students' benches, being, in the one case, fitted in the walls, and in the other, in the piers between the windows. At Munich the closets are formed in the window spaces, by which ample illumination is secured.

(*b*) *Dimensions of draught closets.* The required sizes are shown in the illustrations of Professor Hofman's closets† constructed at Bonn and Berlin, and Professor Roscoe's wall closets at Owen's College. Those at Munich are considerably larger, being chiefly intended for use by students engaged in research. Several larger closets are provided at Owen's College, and

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* Illustn. xiv, fig. 43. † Illustn. xviii, figs. 66-69.

elsewhere. In all cases, however, the variation is mainly in length; the depth and height differing but little. The depth of the closet and the distance of the top of the floor of the closet above the laboratory floor are regulated by the same considerations as those to which allusion has already been made in connection with the working benches in the laboratory. In respect to the height of the closet it is obvious that inasmuch as it is important that the fumes be carried away as fast as possible, it is desirable to reduce the capacity of the closet to its narrowest limits, and therefore it should not be higher than necessary. As ordinarily constructed the closets are too high, because, in the majority of operations which the student in an analytical laboratory has to perform, the apparatus employed rarely, if ever, exceeds 2 feet in height. At Finsbury College the smallest closets are 2 feet 10 inches in height; at Yorkshire College, 2 feet 6 inches; where the students are engaged in research, as at Munich, it is desirable to make a considerable number, if not all the closets, to contain an apparatus some 5 feet high; and in every laboratory one or more such closets should be provided according to the character of the work likely to be carried on. The position of these will necessarily depend on the nature of the space at disposal for the purpose. The average width of the draught closets is 2 feet; ditto depth, 1 foot 9 inches; ditto height, 2 feet 9 inches; and for the larger draught closets the average width is 4 feet 6 inches; ditto depth, 1 foot 9 inches; ditto height, 5 feet; height of bottom of closets above floor, 3 feet.

(*c*) *The sashes of draught closets.* The front of the closets is always inclosed by the rising sashes. The larger the pullies the easier run the lines, which may, with advantage, be of steel, copper covered. But, better still, the breaking of lines and the provision of pullies and weights may all be superseded in light sashes by the spring attachments in common use in railway carriage windows. When the draught closets are in use, it is necessary to raise the sash a short distance in order to admit air, which causes the gas flame burning within to become deflected. To avoid this, at Leipzig, a small subordinate sash is provided, and thus the width of the air slot and its distance above the closet floor can be regulated. At Manchester, this subsidiary sash takes the form of a small glazed flap hinged to the bottom of the closet. At Berlin, a "hit and miss" arrangement is introduced in some of the larger closets, two sliding glass plates with holes being fixed at the bottom of the closet front. On raising the ordinary rising sash, there is necessarily a space between the inner side of the glass and the upper edge of the closet from which fumes escape. Dr. Armstrong has remedied this by fixing to the top of the closet a kind of "squeege" which scrapes against the plate glass. India rubber was at first tried, but this is not only expensive if of sufficient thickness, but it produces considerable friction which ends in twisting, so that it does not preserve a straight line throughout its length. A lath coated with a double thickness of the best carpet felt has, however, been found to answer the purpose completely.

(*d*) *Materials to be employed.* It is almost more important, in the case of the draught closets than of benches, that the "top" should be of an impervious material. In some places slate is used, sandstone and lead are also met with, the former being more generally adopted. It is important, however, to select a stone which is neither readily acted upon by chemical agents, nor liable to crack when moderately heated. Saturation with paraffin, or many of the solutions used for indurating freestones, would probably render it to all intents and purposes non-porous. In many laboratories provision is made for carrying away the liquids which may

be spilt on the floor of the closet, a chase being cut round the edge of the slab, and a pipe being fixed therefrom to the receptacle below. In many cases a jar or other receptacle is placed there into which the students throw all solid waste as well. There is some difficulty in securing a proper material for the roof of the closet. Wood is very liable to warp and crack under the combined influence of the heat arising from the burners and acid fumes and moisture. Slate, although not acted upon by acids, &c., is a treacherous material and liable to crack if heated. Glass, which is always used when the draught closets are in front of the laboratory windows, as at Munich, is less porous than slate, and would, in most cases, be the cheaper material, but it is equally liable to crack. At Strassburg, frames of angle iron have been fitted to the walls and hipped at the angles; upon these a very coarse iron-wire gauze has been stretched, and coated on both sides with Portland cement. The condensation of the vapours under slate, glass, or impervious stone, is an inconvenience which has to be provided against. At Finsbury, the closets have a curved roof of galvanized iron which is coated inside with tar or pitch-varnish. Probably the best and cheapest roof would be made of enamelled iron, which could be cast in one piece, the required size, and be coated with enamel of such a quality that it would resist the action of acids.

(*e*) *The draught flues.* Fumes, &c., are usually extracted from the draught closets through a single opening, square or circular, high up in the back of the closet, the draught being produced in the older laboratories, as at Bonn and Berlin, by means of a gas jet burning in the flue. Each closet has a separate flue, and there is no simpler and more generally effective plan than this, where there are no down draughts or cross currents between the flues to upset their steady action. But several, say a row of, closets may be all readily ventilated by one flue, aspirated by one or more Bunsen burners. This, I am told by Mr. Waterhouse has been found to work well at Owen's College, especially where the "Bunsen" is inclosed with a cast iron cone, with an opening at the top, the iron becoming heated by the burning of the gas accelerates the rush of air. Dr. Armstrong's private laboratory is thus ventilated, as I shall hereafter describe, with considerable success. In most of the recently constructed large public laboratories, however, the flues from the various closets, are all connected with a central flue, and the draught is produced either by means of a tall shaft, at the base of which is a furnace, as at both the Manchester examples and at Birmingham, or by means of a fan as at Munich, Geneva and Aachen, and at the Bristol Trade School.

The question of shaft *versus* fan, has already been discussed in my former Paper, and by Dr. Armstrong in his remarks appended thereto, but it may be well to repeat the caution that competing draughts should never be introduced into a chemical laboratory. No two opposite ways should be provided for the escape of air, and as the draught closets cannot well be too efficient, the whole of the air of the laboratory may be extracted through them.

The introduction of fresh air to the closets, is like introducing fresh air opposite and under a fire-place, it prevents the draught closet, or the fire and its flue, from withdrawing the expired air from the room for its sustenance. Besides which it may permit of air passing into the laboratory whenever the sash of the closet is raised, or it may result in weakening the force of the current of air which should be away from the operator, towards the closet flue. Again, as the closet has a maximum efficiency only when the sash is raised sufficiently to give an opening of about the same area as the area of the flue, it is important that the whole force

of the draught should be in one direction, namely, from the operator towards the flue. Schmidt of Dresden has removed his closet windows in some cases for ordinary operations, finding them work equally well under the hoods without them.

Professor Carnelly writes from University College, Dundee, to say that he believes the system of ventilation adopted there is exceptional, and that it answers very well indeed, contrary to his own expectations, both as regards heating and ventilation. It consists in blowing the air into the building by five large air pumps over heated pipes, which escapes up the ventilating flues and the draught closets. This is the first application of the principle of forcing the warm and cold air into the general laboratory and not otherwise aspirating the draught closets, a principle which has been successfully applied to large assembly rooms by Mr. W. W. Phipson.

The current of air in a draught closet has a maximum force in a direct line with the flue opening, and the other parts of the closet are more or less in "shadow," and vapours hang about them. This may be obviated by making the outlet in the form of a slit (extending along the back of the top of the closet) of equal area to the flue with which it communicates. Very long closets should be provided with trumpet-mouthed slits. Dr. Armstrong has presented us with an example of this kind, which has been constructed in his private laboratory at Finsbury College. It is shown in Illustn. xi, figs. 28-30. The closet is 11 feet 9 inches long and 21 inches deep, but it is divided into three compartments, two of these, one at either end, are 4 feet 5 inches long and 2 feet 9½ inches high in the centre of the curved roof, and 2 feet 7 inches high at the back and front. The central compartment is 2 feet 9 inches long and 5 feet 3 inches high; across the entire width, in the rear, a wooden back is fixed about an inch away from the wall, extending to within 9 inches of the roof, but also having a slit-opening an inch wide 18 inches above the floor, which can be closed by a moveable slide. The corresponding backs of the end compartments are formed of glass to within 2 inches of the roof. The openings thus formed between the wall and the back of the closets extend downwards into the horizontal box flue, 13 inches by 13 inches, which is connected with an ordinary 18 inch by 9 inch brick flue built in the wall. The draught is produced by a Bunsen's gas burner at the base of the shaft, and a velocity of 7 feet per second or about 400 feet per minute in the flue is easily secured by a consumption of about 10 feet of gas per hour.

When draught-closet flues pass directly upwards it is found that condensed liquid and dirt are very liable to drop down into the closet and vitiate experiments there being performed. To obviate this, Professor Hofman made the provision shown in Illustn. xviii. These arrangements have been repeated at Owen's College and at Birmingham, and they are mentioned also in the recommendations of the Science and Art Department at South Kensington. At the Yorkshire College Professor Thorpe has preferred to have descending flues.

(*f*) *Dr. Armstrong's hood arrangements.* In practice, the closets thus far described, although intended for general use, are, on account of their position relatively to the benches, only made use of by students on special occasions, that is whenever it is necessary to perform an experiment with noxious materials, or one which is likely to produce specially noxious fumes. Consequently the hundred and one experiments in which small quantities of acid vapours, &c., are produced are performed in the open laboratory, to the manifest detriment of the purity of the atmosphere, which is further contaminated by the products of the combustion of one or more gas burners for heating purposes usually kept burning on every student's bench. Dr.

Armstrong conceived the idea that this was a very needless and very illogical arrangement and that none of the noxious gases or fumes should be allowed to escape into the room, but on the contrary that all of them should be collected under hoods and carried away, and that the general ventilation of the room should be effected through the same channel. Attempts have been made to bring the draught closet so near to the student that he should not be tempted to vitiate the atmosphere; and at Aachen, Owen's College, the Bristol College and the Manchester Grammar School, a small draught closet is provided on each student's bench, illustrations of which are given. That at the Manchester Grammar School,* which was planned by Mr. Francis Jones, the Head Master, is especially deserving of attention. As will be seen by the drawings, each closet is 15 inches high by 10 inches by 10 inches area; two such closets are placed back to back, and the flue which is common to both is of porcelain, being ingeniously constructed with a diaphragm down the centre, so that each closet may have its fair share of the "pull." But there is little to enforce the use of this provision when made, and the gas burners are mostly exposed as before. Therefore I view with considerable interest the system which has been initiated by Dr. Armstrong and carried out under his supervision at the Finsbury Technical College,† because it promises to afford a satisfactory solution of the problem under consideration. A "heating shelf," 22 inches wide, is fixed 12 inches above the bench, and over this is a hood 24 inches wide of the shape and size shown. At intervals of 4 feet under this hood, 4 inches square iron down-cast flues, pitched inside, are connected with the horizontal flue channels in the floor. Wing plates are attached to these down-cast flues, forming a continuous extract flue opening, extending the whole length of the hood. By raising and lowering these plates, by means of the screws at B B and B, the width of the opening can be graduated at will, and made wider at B than at A A in order to secure an even pull along the entire distance between the down-casts. The flexible tube of the gas burner attached to the tap below, is passed through a hole (C) in the heating shelf, and all operations, other than those with a mouth blow-pipe, must be performed on the heating shelf, and thus necessarily under the hood, so that whatever fumes are evolved they are sucked away. In order to compel the student to heat large vessels, such as flasks or dishes in the most favourable position, that is, well within the hood, no moveable stands are provided, but instead thereof, rings, such as are shown in the drawings. The arm opposite to the ring is bent at right angles and is filed to a conical shape, so that it fits closely into a corresponding eye-hole in the brass plate, screwed on to the down-cast pipe. An opening XX, 3 inches by 2 inches, is made in either side of each down-cast, and all operations involving the sudden evolution of noxious fumes, are conducted immediately in front of this opening. When not required it is closed by a small door. Hoods of this kind have been made 12 feet long and used with most satisfactory results. Before very long a whole series will be seen at work at Finsbury Technical College. Alterations are at present being made, and experiments carried on to test the most efficient of several modes of actuating the draught in the main extract shaft. When this is satisfactorily completed, a very interesting and useful addition will have been made to chemical laboratory fittings. The whole of the hood and even the wing plates might be made of glass, but in this case the depending sides are alone glazed.‡

* Illustn. iii. This School was erected from the designs of Messrs. Mills & Murgatroyd. † Illustn. ix.

‡ Professor Roscoe expresses himself in favour of draught places for heating purposes on each bench, with down draught to chimney.—E. C. R.

iii.—Draught Closets for Special Purposes.

(*a*) *Sulphuretted-Hydrogen Closets.* At Owen's College small closets, 12 inches high and 85 inches in area, are provided on each bench [Illustn. iv, figs. 10-14]; a wooden flue, 5 by $5\frac{1}{2}$ inches, in the corner of the closet, connects it with the floor channel flue leading to the shaft. Each student himself prepares the gas as wanted. In most laboratories, however, a special room is provided for operations with this most unpleasant smelling gas. Either a constant automatic apparatus for generating the gas is provided for common use, or it is stored in a gas holder and served by pipes to the bench or special closets—such special closets are represented in the drawing of the sulphuretted-hydrogen chamber at Leipzig [Illustn. xvii, figs. 63, 64]. A series of small wooden closets are provided, all of which communicate with the main flue in the manner indicated through narrow slit openings at the back. There is a supply of the gas to each student. Two of the closets are larger than the others, and there is one for still larger operations, which are also provided with gas burners for heating. A similar form of sulphuretted-hydrogen closet, at the Graz Laboratory, is shown in Illustn. xvii, fig. 62. The chambers are of glazed stoneware; no fronts are provided, but these chambers are all inclosed within an ordinary large draught closet. A somewhat more novel arrangement, at the Finsbury College, is shown in Illustn. iii, fig. 9; small copper funnels, $3\frac{1}{2}$ inches wide at mouth and 4 inches high, are fixed to the flue X at the top of the closet; the gas is generated in the central chamber Z, and thence passes to the copper tubes soldered into the sides of the funnel, a small pinch-down cock being fixed to the flue as at B. The student attaches a length of glass tubing to the copper tube by a short piece of caoutchouc tubing, or raises the flask on a stand, and then proceeds to pass the gas into the solution he is testing. All excess of gas is thus delivered directly into the flue, the connecting tube being of such length that the mouth of the vessel containing the solution is within the funnel. Any further operations with the solution, such as boiling or filtering, are also conducted in the closet, gas burners being connected with the taps, and filtering arms being hinged to the panels of the closet. Usually the student uses the closet only to pass the gas into his solution, all further operations being conducted at his bench.

(*b*) *Evaporating closets.* It is customary to provide one or more evaporating closets, *i.e.*, closets in which evaporations by steam can be conducted. These closets, however, do not materially differ from those already described, the fittings being the special part of them. Dr. Armstrong has explained to me that it is particularly desirable to have a sharp draught across the surface of the evaporating liquid, and it is to be expected that a slit opening combined with a low roof will be found of especial service in such closets. The main difficulty is to prevent condensed liquid dropping into the vessels below; and there is still ample opportunity for the exercise of ingenuity in the construction of a really efficient evaporating closet. Probably much that is now done by steam might be more economically and satisfactorily performed by hot air; that is to say—properly regulated burners might be placed in such a situation relatively to the heated vessels that the temperature could not exceed that of boiling water. Professor Thorpe has elaborated a good example.

iv.—Demonstration Table and Fittings.

A demonstration table is not provided in every laboratory, but only in those where large classes have to be dealt with, as at the Finsbury College, the Manchester Grammar School,

and St. Bartholomew's Hospital. It is seldom found in German laboratories, where, as a rule, the students are engaged during the greater part of their time, and get much individual attention from the teaching staff. The table should be placed so as to command the working benches, and set upon a platform raised about 12 inches—see the Manchester, the Finsbury, and the Dundee examples. At the Grammar School, and at Dundee, the table is fitted with drawers, cupboards and recesses, for storing the various articles which have to be issued to the students during the lesson, and is also provided with gas, water and a sink, so that experiments can be performed upon it before the students. At Finsbury, as already explained, the space under the table is not actually used as a demonstration table; but the balances for the junior students are placed at the one end, and the assistant has his desk at the other. In a small cupboard below are a series of wooden trays, into which bent hooks are screwed for the student's keys, a number corresponding to that on the student's bench being stencilled below each key. By thus keeping and giving out the keys at the commencement of the class, and insisting on their being returned at its close, loss is avoided, and the key board also serves as an " attendance indicator."

v.—Lecture-room Fittings.

(*a*) *Lecture Table.* This is the most important fitting in a lecture-room, though one which does not greatly vary in form or character in different laboratories. It is and should be always a long rectangular bench, never curved or circular on plan. Its general height is about 3 feet, its breadth about 2 feet 9 inches, and as it is not desirable that one piece of apparatus should be placed before another, there is little advantage in having wide tables. As to length, there is no limit; the longer the better would be the dictum of most chemists. The table should have a hard-wood top; and now-a-days, as a matter of course, "down draughts" must be provided, that is to say, there are openings (usually two), not less than 4 inches diameter, in the table-top, which can be closed with moveable covers, and pipes from these communicate either with the main flue, or, where there is no special system of ventilation, the taps are carried down under the floor into a flue in the wall, where there is a gas burner to produce a draught. A portion of the table-top is often made moveable, and underneath is a large sink, which can be filled with water and used as a pneumatic trough in transferring gases, &c. This sink is sometimes glazed back and front as at Dundee. A shallow tray for operations with mercury is also sometimes constructed in a similar manner under the table-top. The space under the table should be fitted with drawers and cupboards for the store of various articles and apparatus required by the lecturer. A considerable number of gas and water taps are necessarily provided, and are usually fixed in such positions that they can be readily got at without being in the way of apparatus. In many of the luxuriously appointed modern laboratories there are numerous other taps fitted to the lecture table, some being for the delivery of compressed air, while others are in communication with a vacuum pump; others again furnish a supply of oxygen, and others steam. Wires from a dynamo-machine or some other source of electricity are also attached to proper terminals affixed to the table. Obviously all these special requirements can only be properly provided for when the architect is placed in direct communication with those who will have charge of the teaching; it is important that he should know of them, in order that he may not be led into the error of assuming that a

mere table is all that is required. The chemical and natural philosophy lecture-tables at Dundee [Illustns. xiv-xvi], are very complete, taken with their surroundings. The former is 20 feet long, 3 feet wide and 3 feet 1 inch high, on a platform 12 inches high. Teak is used for the table-top and for the frames of the mercury and pneumatic trough. The front and ends are of pitch pine and the back and framing of yellow pine.

(*b*) *Draught Closets.* One or more draught closets are usually provided behind the lecture table, one being of large size for the performance of experiments with large apparatus, the others being small. Where draught closets are provided on the table small closets are scarcely necessary. The large closet is frequently so constructed that its working bench is put on wheels, and thus it can be moved either into the preparation-room or into the lecture-room, as at Dundee. This arrangement renders it possible to bring forward, when required, a furnace or other piece of apparatus which it is not desirable to keep on the table during the whole of the lecture. The drawings of Dundee [Illustn. xv, figs. 48-51] and Finsbury Colleges are good typical examples of the treatment of wall-space in the rear of the lecture table.

(*c*) *Other Lecture-room Fittings.* One or more black boards, a diagram screen, a large white spring roller blind or screen for use with the "magic lantern," and a set of reagent shelves, are all requisite fittings for the lecturer. The "black boards" are frequently arranged to come down over the glazed fronts of the draught closets; they should be suspended from large pulleys by copper-covered steel bands, to move easily. Usually they are of wood; best ground plate glass, securely mounted in a wooden frame, may be used with advantage if coated on the under side with a mixture of lamp black and size. For use at night, a white board is very convenient, the back of the glass being coated with ordinary white distemper. A "flashing platform" should be arranged for projecting pictures on the screen, and so placed as not to obstruct the students' view of the table. For darkening the lecture-room special black holland blinds are usually provided, running in grooves at the sides, or revolving shutters.

vi.—Preparation-room Fittings.

Here there should be a large table, on which the apparatus to be used in the coming lecture is set out, and also a working bench for the assistant's use. Cupboards, shelves and drawers for apparatus in constant use should be as liberally provided as possible. A number of glazed cases for the storage of apparatus and for specimens and diagrams are necessary, but these may be in an adjoining room. Space should be allowed for a carpenter's bench, lathe and vice, an anvil, a soldering bench, and a blow-pipe table. There should be a large sink and draining table, with perforated shelving above; and near to this, if possible, there should be a large drying closet, in which glass can be placed to dry. A supply of hot water to a sink is also very useful [Illustns. i, vii].

vii.—Store-room Fittings.

It is desirable, if possible, to have two store-rooms, one for glass and other apparatus, the other for chemicals, this being used also in making up the reagents for students' use. The former should be liberally fitted with bins, cupboards, drawers and shelving, solid and skeleton. The latter should be similarly provided, but should also have a working bench for the use of the assistant in making up reagents.

viii.—Class-room Fittings.

These should be of the same kind, although not nearly so extensive, as the lecture-room fittings. The indispensable requisites are a table supplied with gas and water, one or more glazed cupboards for apparatus, chemicals and specimens, a black board, a diagram screen, and some arrangement for carrying off noxious fumes. For the last purpose either a down draught may be provided on the table, or a draught closet may be constructed against the wall behind the table. If the latter, a sink may be conveniently placed within the cupboard instead of upon or near the lecture table, and the black board may be arranged to fall down in front of the closet.

ix.—Balance Room and Library.

The main requisites of a balance room are a number of benches to carry the balances. To diminish vibration as much as possible, it is best to have a separate small bench for each balance, and to fix these upon brackets let into the wall. As the balance room is frequently made use of as a reference library, a table at which students can read and write should be provided, and a cupboard for books; although, if space and funds permit the balances are better kept apart. A large table for use in the preparation of diagrams is an important requisite, and may conveniently find a place in the balance room [Illustn. xiii, fig. 40]. The top ought to be moveable and adjustable to any angle, so that the draughtsman may stand in front of the board; brass scales are let in at the top and at one side, so that lines may be readily drawn at any required distance with the aid of a T-square. This table takes the centre of the room at Finsbury. On the drawings are shown the details of the benches.

x.—Assistants' Room.

In the assistants' room there should be a working bench for their use, a draught closet or hood, and a sink and draining table, cupboards, drawers and shelves should also be provided, in which special apparatus, such as measuring vessels, platinum crucibles, agate mortars, &c., continually required, may be kept, as also pure chemicals, &c., for analysis.

xi.—Rooms for various Special Purposes.

The number and character of these must depend to a large extent upon local requirements, but the following are met with in all large laboratories:—

(*a*) *Gas analysis room.* This is a room in which analyses of gases are performed. It is usually regarded as essential for its temperature to be maintained as uniform as possible, and therefore the room has almost invariably a northern aspect; now, however, that it is becoming customary to make the measurements in water-jacketted tubes, this is less important than formerly. As mercury is liable to be spilt, the floor should be laid with special care; but as it is almost impossible to make the floor continuous, it is well to cover it with linoleum or some such material, and to fix a bead over this, so that whatever mercury is spilt may be swept into a corner and collected. At the Central Institution a cement floor is formed with a semi-circular sunk groove round to catch the quicksilver. The fittings comprise, one or more mahogany-topped tables, and a cupboard for storing apparatus; gas and water should be laid on, and a sink provided.

(*b*) *Spectroscope and polariscope room.* In working with these instruments it is necessary to exclude light, and therefore to provide blinds for darkening the room; in other respects

the only requisites are steady benches, a supply of gas and water, and a sink. The benches should be somewhat low, so that the observer at the instrument can be seated.

(*c*) *Photometric room.* This room may be distinct from that last referred to, but the two are sometimes combined. It should, if fitted with the requisites for testing the quality of illuminating gas, be provided with a dark blind, and in order to accommodate not only the photometer, but also a working bench, a draught closet, a gas holder, &c., it should be spacious in size. A liberal supply of water and gas, as well as a sink are necessary.

(*d*) *Combustion room.* This is a room in which gas furnaces for heating long glass tubes are placed. It is usual to provide one or more benches against the walls, with stone tops about 2 feet wide and 2 feet 9 inches above the floor level, iron hoods communicating with flues in the walls being fixed over these benches. The gas main is best fixed in front of the bench.

(*e*) *Explosion or cannon room.* This is a room in which sealed tubes are heated in air or oil baths. The benches should be of stone, and in several laboratories the baths are placed in small open-fronted closets with stone sides and top, so that when an explosion takes place the glass may not be scattered about the room. The room should be especially ventilated and there should be an opening into the flue from each of the compartments referred to.

xii.—Metallurgical Laboratory.

Here the wind, muffle and other furnaces, required for assaying and for fusion of metals, &c. are placed. The fittings are of a special character, and may be seen in laboratories like that at the School of Mines, and at King's College. Fittings of the kind are in course of construction at the Merchant Venturers' School, Bristol. The room should be very well ventilated into the shaft provided, and the heated air collected by a hood over the range of metal ovens and furnaces.

xiii.—Special Operations Room.

In every laboratory there should be one or more rooms for the performance of large operations, which cannot well be carried on upon the student's bench in the main laboratory. It is desirable that, while some of the benches in the special operations room are of the average height, others should be lower. They should be as free as possible from upper works. The floor should be of asphalte; and some of the benches should be of hard wood or covered with lead, while others should be of stone. A large sink and a draining table are required, and a supply of both hot and cold water. Several large draught closets should be ranged round the room. Steam should be laid on, and if possible motive power should be introduced into this room. Shelving and cupboards must not be omitted.

MECHANICAL LABORATORIES.

i.—The Lecture Room.

At Finsbury this is also the physics' lecture room, with large diagram space, and a large and easily moved black-board. It is not sufficiently well known that black-boards require to have great length horizontally. In many mathematical class rooms they are fixed to the wall, because of the difficulty of hanging them so that they shall be easily moved. Professor James Thomson of Glasgow has originated a method of hanging black-boards from levers, which proves very convenient at Finsbury [Illustn. xii, figs. 31-37]; there, a black-board 14 feet long and 6 feet high, can be moved up or down, through a vertical height of 6 feet, by the lecturer, who need not stop

his writing as he shifts the position of the board. A separate lecture room is necessary for the mechanical department of a college. Firstly, because the room ought to be to some extent a general mechanical laboratory, and requires special wooden beams on the walls and supports in the ceiling for carrying heavy apparatus. Secondly, because students ought to be able to sit at the desks if the lecture is one of which they have merely to take notes; and they ought also to be able to stand at the desks. Indeed, the tops of the desks ought to be constructed to rise and become more horizontal, as a lesson on practical geometry or graphical statics requires the students to stand while drawing. At Finsbury moveable tops give a broad horizontal table for students when they require to draw; these can be lifted off for ordinary lectures, and stowed underneath the fixed desk, where they create no inconvenience. It is only to every other row of desks that it is desirable to provide this moveable top, to allow passages for students between the rows of draughtsmen. In a specially arranged lecture room this moveable top for draughtsmen who stand would sink in position, and become inclined for note-takers who sit. In all cases grooves and recesses for drawing instruments and colour saucers must be provided.

ii.—General Laboratory.

The aim of the professor of engineering at a college has hitherto been that of providing one laboratory where he and a few senior students may obtain results which shall be of use to all engineers. With one exception there has been no attempt to create, and there is probably no great desire for, a general laboratory, in which *all* students at a college may make quantitative experiments during their whole study of mechanics. It is, however, the opinion of Professor Perry that there should be such a general laboratory, and although his space at the Finsbury College is quite inadequate, he has there attempted to carry out this idea. He says that there ought to be one room not less than 25 feet in breadth, and 50 feet in length, with a small room partitioned off at one end, say 25 feet by 10 feet, for students using the more delicate apparatus, and a room of about 25 feet by 15 feet partitioned off at the other end. This should have a concrete floor, a sink, and high and low pressure water supply for hydraulic experiments. The ceiling and walls ought to be crossed everywhere with timber beams sufficiently large for the fixing or hanging of machines and apparatus. A supply of small stout tables of about 3 feet high; plenty of light; the ceiling as high as possible, but not less than 15 feet.

iii.—Special Laboratory.

The character of the fittings of this room which is (except at Finsbury) the only kind of mechanical laboratory usually provided at a College, depends on the nature of the researches to which the professor devotes his leisure time. A mechanical laboratory, says Professor Unwin, may be intended for researches of any kind. Testing materials for strength (iron, steel, cement for example), or testing lubricants, or testing fuels; testing the efficiency of hydrants steam or transmissive machines; for hydraulic researches and researches on the resistance of ships, &c. Therefore the arrangement of a mechanical laboratory must depend on the particular line or lines taken up. Professor Kennedy at University College and Professor Unwin at Cooper's Hill, have laboratories in which the chief work is that of testing the strength of materials. Professor Smith of Birmingham chiefly makes experiments on the steam-engine; Professor Huntingdon at King's College, London, devotes his laboratory mainly to

metallurgical work. That is, not only for assaying, &c. but to the composition and testing of alloys of metals with a view to the discovery of the best proportions for the various uses of brass, and other compound metals in engineering works and mineral extractions. At Cooper's Hill, the testing laboratory is 60 feet by 25 feet, with open roof and a small room for plotting results and keeping valuable apparatus. There is a hundred tons testing machine, a lathe, slotting machine, drill, emery wheel, small forge, vice-bench and gas engine for driving machines. There is also a cement testing apparatus, a small lubricant tester, and some German hydraulic experimental apparatus. Professor Unwin considers the light should be northern if possible, the room should be lofty, and the shafting fixed at a good height. A travelling crane over the large machine is a great advantage. Professor Perry tells me that his students in Japan experimented with a large testing machine on numerous specimens of Japanese timber as well as on metals. They tested oils, the strength of cement on a special machine, the strength of bricks and stones with a hydraulic press. The same room also contained an engine and boiler with special fittings, to enable the efficiency of the steam-engine to be investigated. It is therefore obvious that in the matter of special laboratory fittings, the architect must consult the professor who is to be in charge of the instruction researches.

iv.—The Engine Room.

Where the Professor of the department cannot be consulted, it is well to recollect that the engine must not only drive the workshop and other shafting of the College, but must be available for experiments. It ought therefore to be high pressure and condensing with expansion valve controlled by a good governor. The room must be large so that extra tanks and pipes may be introduced. It is found that the evaporative condenser on the roof causes less water to be consumed than in the same size engine when non-condensing; as it is felt that this kind of engine will probably be largely introduced, the nature of the two large pipes for circulating pump and two for steam, shown on the drawing, going from the basement to the roof, is of some importance to the architect. It would be better that they should not be exposed to the weather. At Finsbury where they had to be placed outside, they are emptied of water every night in the winter time. The arrangements of boiler, boiler seating and chimney, and of the shafting to the various parts of the College, are matters in which the advice of a mechanical engineer is necessary to the architect. The shafting to various workshops, &c., must be arranged before walls are built, as metal wall boxes must be provided for.

v.—Workshops.

The fittings which concern the architect after the shafting has been put up, are the vice-benches in the iron workshop and concrete foundations for some particularly heavy tool, such as a shaping machine. The lathes will not require special foundations. The carpenter's benches are the principal fittings of the wood workshop, which also possesses a few wood-working lathes and a hand saw. The benches not less than 4 feet apart ought not to be less than 3 feet wide, and ought to be provided with at least one drawer for every two students; vices of the sliding-clip pattern; plenty of space allowed round the ends of the benches. A space of not less than 12 feet square ought to be available for hand-sawing. The iron and wood workshops ought to be kept distinct, and the area of each shop ought not

to be less than 1,300 square feet for twenty students working at one time in one shop. At Finsbury the allowance is only about 900 square feet per twenty students, more space being greatly needed. A room for workshop stores must be provided at least 20 feet in one dimension, the other dimensions depending on the size of the workshops. This room ought to be filled with pigeon-holes, racks and shelves. Every student ought to have a locker at least 24 inches by 15 inches, by 15 inches.

vi.—Melting-Room and Smithy, or Metallurgical-Room.

In the basement plan [see Illustn. v] of Finsbury College is shown the smith's forge, with bellows worked by the shafting provided and shown. A brass furnace, brass moulder's trough, stone benches and other fittings, are required. This room belongs partly to the Mechanical and partly to the Chemical Department, but the three furnaces belonging to the chemists or metallurgists are not shown on the drawings.

vii.—The Drawing Office.

At Finsbury the space is so limited that it has been necessary to give one common flat table to eight students, two of whom generally use it at the same time. For every twenty students using the drawing office a space of at least 1600 square feet should be provided, and the light ought to come in as much as possible to the left front of a student. It will be seen from Sir F. J. Bramwell's design [see Illustn. xiii, figs. 38, 39] that no cupboards for drawing-boards or squares are required, but a set of large shallow drawers are needed for a stock of paper, finished drawings and other stores. It is well to provide a black-board for this room, and a set of wash-hand basins.

viii.—Museum.

Professor Perry tells me that the arrangement adopted in Japan was found to be very satisfactory. A room which was probably 120 feet long and 24 feet broad, had a row of windows along one side. It had three long stout benches—two along the walls, and one along the middle of the room, and on these benches, not too close together, rested specimens of mechanism and structures, models of steam and other engines, broken specimens of iron, &c. There was no attempt to put the models one behind the other. Each was easy to get at, and there was no resting place (except for a few exceptionally large models), except on benches all of the same height. Photographs of machinery hung on the wall fronting the windows.

EDWD. C. ROBINS.

[Remarks by Professor Carey Foster, F.R.S.]

The requirements of physical laboratories are more difficult to treat, from a general point of view, than those of chemical laboratories, seeing that the operations are of a more varied kind. The routine work of a student's laboratory for chemistry mainly consists in analytical operations which do not require a great deal of space, and for which the arrangements, in the case of all the students, are very similar. But in the physical laboratory a variety of subjects is dealt with. Experiments with light, heat, electricity or sound—all these different subjects require special arrangements in order that the operations may be properly carried out; and very often, even

an elementary operation, such I mean as would be put into the hands of a beginner on the subject, may require a very great deal of room. In a physical laboratory we must have steady supports independent of any shaking of the room due to traffic outside the building, or to people walking about in the building itself. How this steadiness is to be obtained when the ground itself is in tremour is a difficult matter. It has occurred to me that it may be possible to obtain it by means of floating supports, but I do not know that any experiments have been made in this direction. Years ago I had some knowledge of chemical laboratories and, amongst these, of the old chemical laboratory at University College, London, which has not been referred-to to-night, namely, the Birkbeck Laboratory, which I think I am right in saying was the earliest student's laboratory established in this country. Each working-bench was there provided with a ventilating hood of stoneware, and a separate sulphuretted-hydrogen chamber, besides which there were evaporating closets for general use on a large scale. It was built in 1845, or thereabouts, by Professor Donaldson, and though later laboratories have carried out the arrangement attempted there in a more effective way, the old Birkbeck was certainly good as a first attempt.

T. CAREY FOSTER.

[Remarks by Professor Thorpe, Ph.D., F.R.S.]

Steadiness in buildings destined to contain laboratories for chemical and physical research is essential. In buildings which have not been originally arranged for the purposes of a physical laboratory, this may be somewhat difficult to secure. Professor Andrews, of Queen's College, Belfast, as most physicists are aware, has had to make experiments, in which a very high degree of steadiness was necessary. The building at Queen's College, Belfast, was not well adapted to his work, but he found he could get a sufficient degree of steadiness by introducing underneath the floor heavy wooden beams, in which all the apparatus necessary was directly placed, so that the experimenter in walking over the floor, the floor being entirely disconnected from those beams, only gave the smallest possible tremour to the apparatus.

The width between the working benches, in which the practice of designers of laboratories seems so variable, is a matter of importance. I am not aware that any other principle guided me in the selection of the special width we adopted, than to take care that there was sufficient passage-room for a student to pass between the cupboard doors on either side, when open. A great deal has been said with respect to the character of the wood, of which the table-tops should be, and numerous experiments have been made. There is nothing more annoying or unsightly than either to see the wood become discoloured or see it split, as not unfrequently happens from the heat radiated from various pieces of apparatus in use. I believe, Dr. Roscoe, some years since, when devizing the fittings for the laboratory of Owen's College, made a number of experiments on this point, and found that, of all the woods he tried, green-heart came out the best; but I understood there was a practical limitation to its use on account of its expense.

With regard to the question of sinks, we find, at the Yorkshire College, in the temporary sinks with which we have been working for some years, that very much less of sink accommodation than that usually provided suffices us. I find, for example, that one tolerably large sink of rectangular shape, placed so that four men can make use of it at once, is all that

is necessary. It seems to me waste of table space, and of course of money, to put up a sink for every student. We have tested that matter rather thoroughly, and I find not the slightest objection raised by the students to the arrangement now adopted. One point more in connection with this matter is perhaps worth noting. In most large towns the water-pressure is of course very considerable, and in some public laboratories care is taken to reduce the water-pressure. The high pressure has this great disadvantage, that it is almost impossible in using the taps to prevent a great deal of water being spilled about the tables. The water rushes into the basin with such force that it is projected over the table. That was got over in a very simple way in Professor Baeyer's laboratory in Munich. There the sinks, instead of being made rectangular, had oblique sides, so that, when the water was shot in, it struck the side inclined inwards, and was not so readily spilled over the tops. It was, I understood, on account of the difficulty of making stone-ware sinks of that kind, that Professor Baeyer used oaken troughs, which he says, in his published account of the laboratory, answer fairly well. There is one slight disadvantage about the use of stoneware, owing to the liability of fragile glass vessels to get broken, for of course if they strike against a hard non-yielding substance they are apt to get fractured; there is an advantage in the use of wood on that point. I shall try to get over that in my case by putting, at the base of the sink, a very thin movable slip of perforated india-rubber.

Much has been said about the use of the sulphuretted-hydrogen closets and properly so, because they are very essential in the fittings of a laboratory. With respect to their working, it is an excellent system to have a large store of sulphuretted-hydrogen, but, as evolved from gasometers, it has this disadvantage: it is almost impossible to properly regulate the currents through the various liquids into which the gas may be passing at any one time. What I mean is that supposing you have a very small volume of liquid of only 2 or 3 inches in depth, such an amount for example as a student engaged in qualitative analysis may have to deal with, and that you have side by side with him a student engaged in quantitative analysis, who may have large beakers full of fluid, the qualitative student gets far more gas than he wants, and the quantitative student gets very little.

E. T. THORPE.

[Remarks by Professor Armstrong, Ph.D., F.R.S.]

A Paper like this is a little likely to mislead, inasmuch as Mr. Robins has brought forward principally what may be called high-class examples. Most of the requirements for ordinary school laboratories are not so extensive as those of laboratories of the class mainly dealt-with in the Paper, and if anyone would follow Mr. Robins, and deal with the question of school laboratories, and would point out what can be done in providing for their more modest requirements, material service might be done towards introducing experimental science-teaching into our schools. Unquestionably every school in the country will, within a few years, have its physical science laboratory. There are certain points which have not been dealt with in the Paper, notably, the lighting at night. Up to the present time it has been customary to employ single burners. In my opinion it is very important that we should get rid, as far as possible, of the products of combustion from the gas-burners, and economize as much as possible in the use of gas. At the present day we know certain very improved

methods have been introduced, and that we can get almost double as much light out of our gas as we do by the use of ordinary burners, and that we can so burn our gas as to entirely withdraw the products of combustion. Another point of great importance is the provision of regulators on the gas supply. It is very well known that, when you increase the pressure of gas, you do not get an increase of light in proportion to the increased amount of gas burnt. Therefore it is essential that these governors, of which there are now numerous efficient forms, should be used to regulate the gas supply. But certain points have to be taken into consideration when this is done. In the first place it is necessary to have larger mains—otherwise the supply is not sufficient; and it will be necessary to abolish sun-burners, as in order to maintain the flame horizontal it is necessary to burn the gas at a high pressure—about 1½ inches at least. I have met with two cases lately in which it was attempted to use governors, but they were soon discarded because then it became impossible to make use of the sun-burners.

HENRY E. ARMSTRONG.

[Remarks by Professor Perry.]

The construction of the black-board will probably not have been sufficiently evident from the drawing [see Illustn. xii], and as it is of some importance in connection with the hanging of all heavy objects, which ought to move up and down easily, I will describe the principle of Professor James Thomson. It is absolutely necessary that the lecturer should not rub out a mathematical formula until the end of the lesson, and this requires a very long black-board, the longer the better. As one who has to teach mathematics, I should say that a black-board ought not to be less in length than 30 feet. A long black-board is usually fixed to the wall. You can write, perhaps, at from six feet from the ground to three feet, but it saves much mental worry to be able to write all formulas at about five feet from the ground. It is therefore of importance to move the whole of the black-board up and down with a touch of the finger, as Professor James Thomson's arrangement enables you to do, instead of doing what might suggest itself at once to everybody: hanging the black-board by two chains over four pulleys, and having a very heavy balance-weight for the whole of the board, which involves a most tremendous amount of friction. We hang the ends of the well-framed board by two chains from the long arms of two levers. The shorter arms of these carry a heavier balance-weight, and the only places where friction can occur are the fulcrums of the levers. This allows a very large motion of the board for a small motion of the balance-weight, and is exceedingly convenient. When these fulcrums are slightly oiled, a touch of the chalk at any part of the board is sufficient to lift the black-board. I put this before the members, because I am quite sure that there are many cases in which heavy hanging things have to be put up, and in which this simple principle might conveniently come in.

JOHN PERRY.

II, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS. (i).

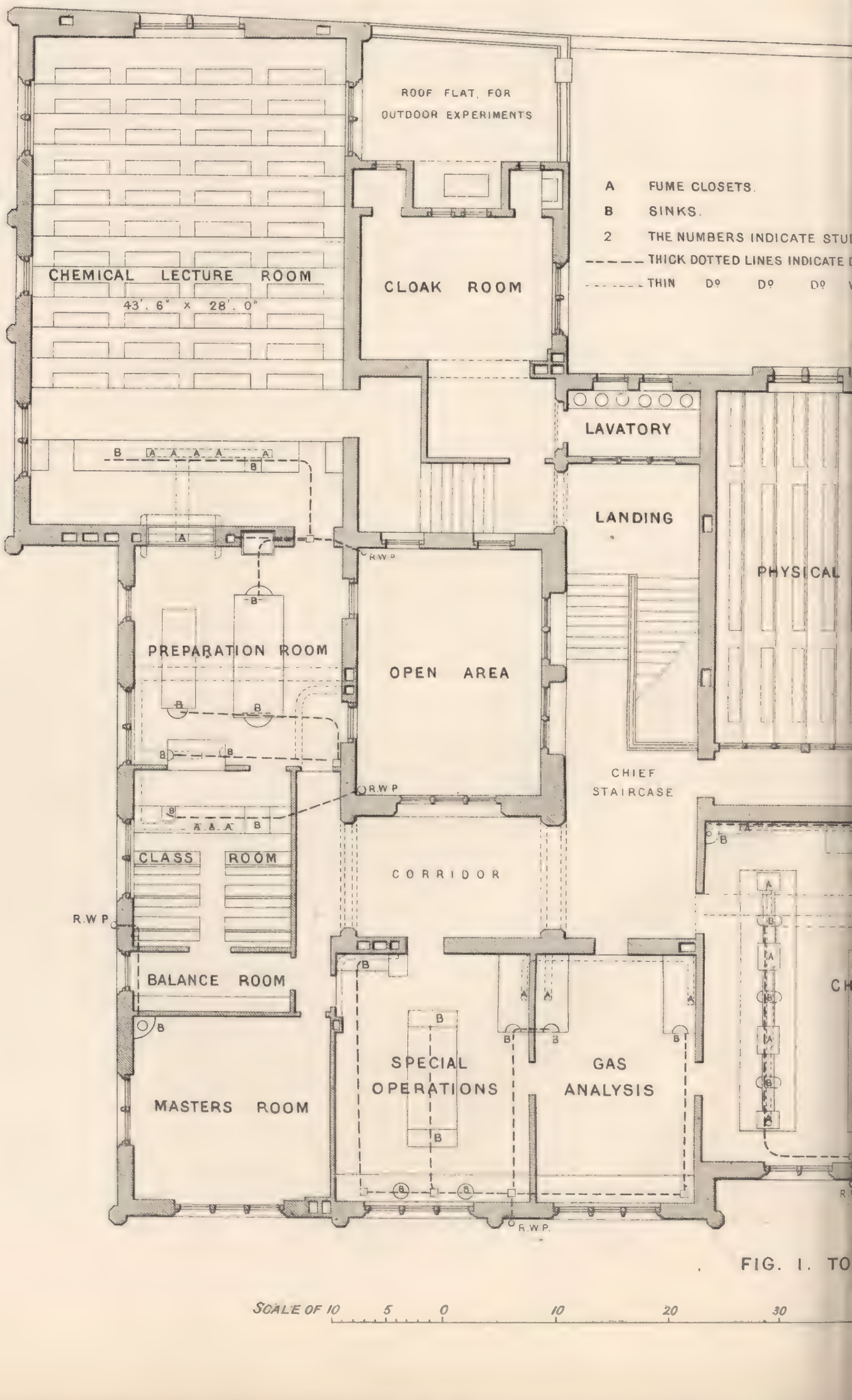
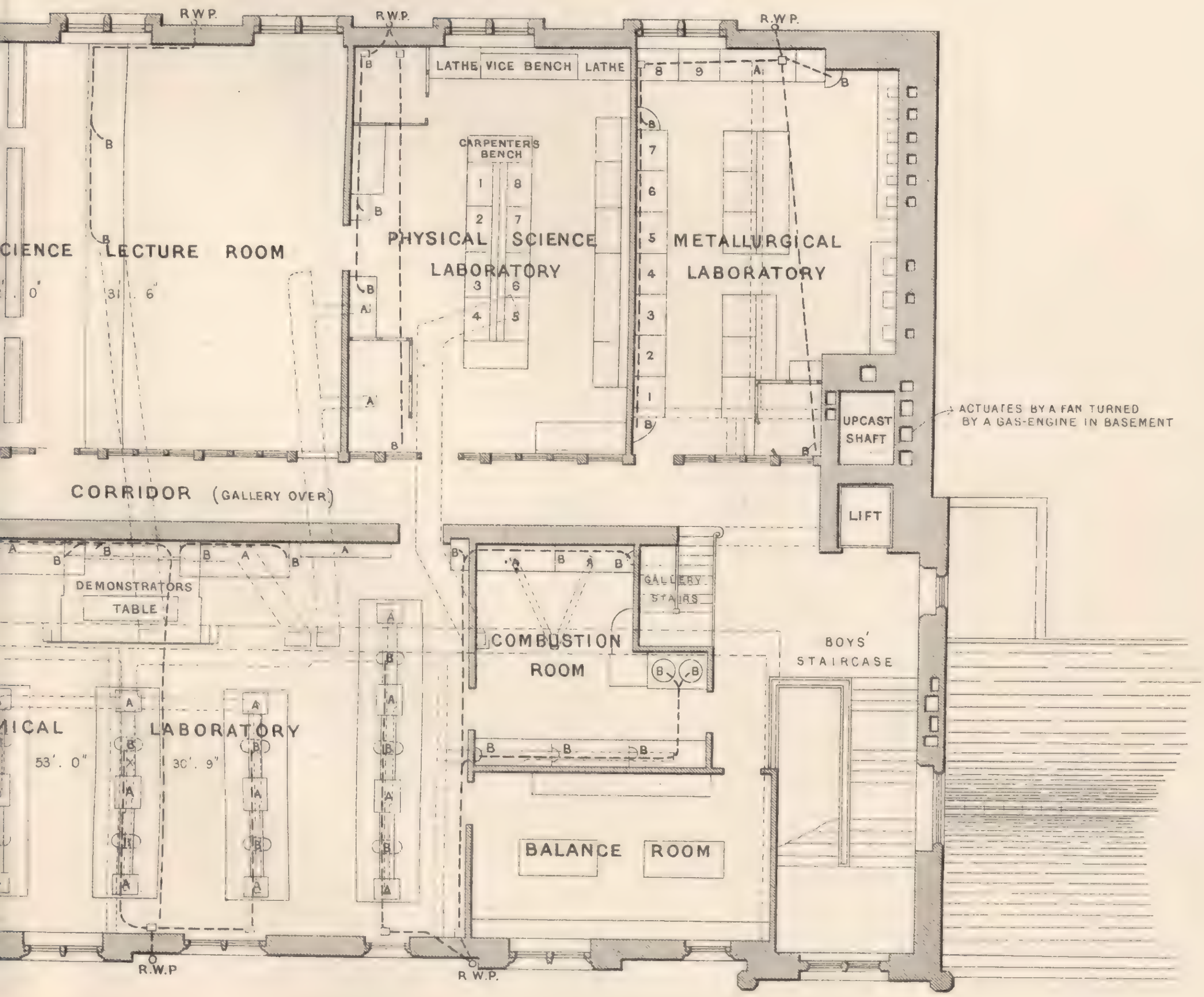


FIG. I. TO

THE MERCHANT VENTURER'S TRADE & MINING SCHOOL, BRISTOL.

E. C. Robins, F. S. A. Archt.

TS BENCHES.
NS FROM SINKS.
ILATING CHANNELS IN FLOOR.



MOST FLOOR.

40 50 60 70 80 90 FEET.

C. F. Kell. Lith 8, Castle St. Holborn. London. E.C.

II. FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS. (ii)

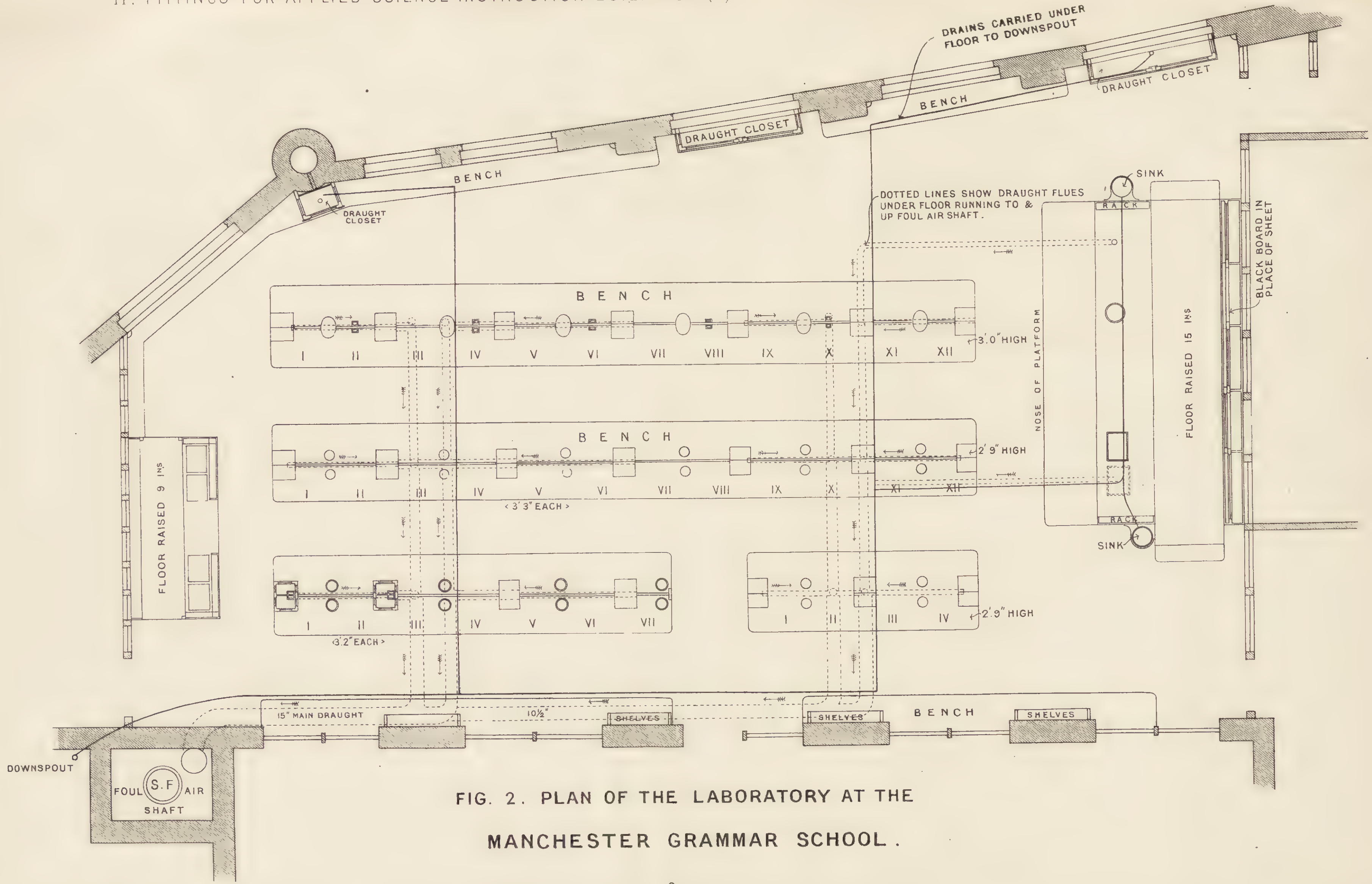


FIG. 2. PLAN OF THE LABORATORY AT THE

MANCHESTER GRAMMAR SCHOOL.

SCALE.

INS 12 6 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 FEET.

C. F. Kell Lith 8 Castle St. Holborn, London, E.C.

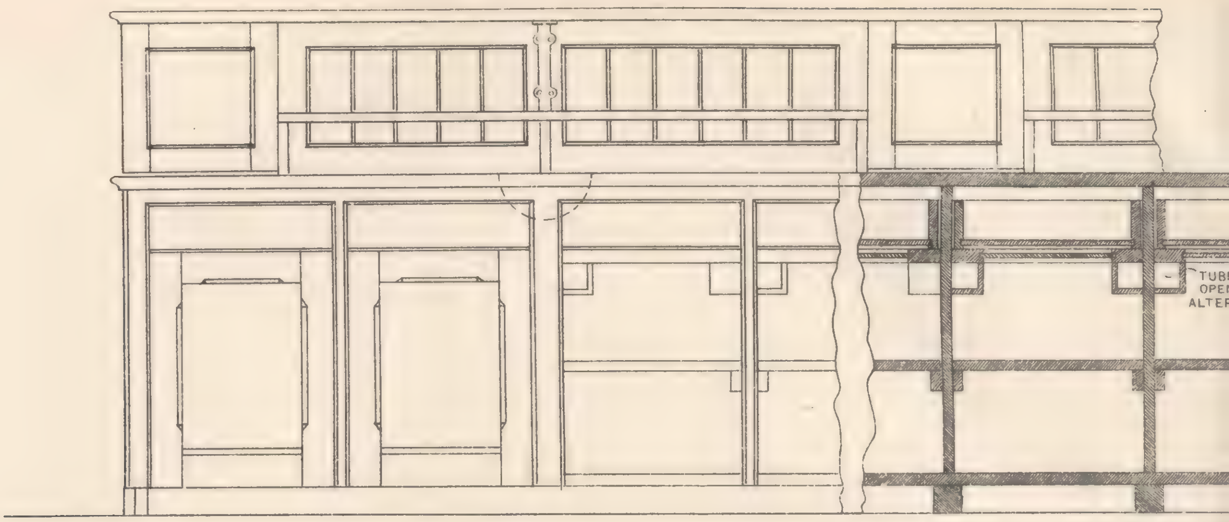


FIG. 3.
FRONT ELEVATION.

FIG. 4.
LONG! SECTIO

MANCHESTER GRAMMAR SCHOOL,
STUDENTS BENCHES.

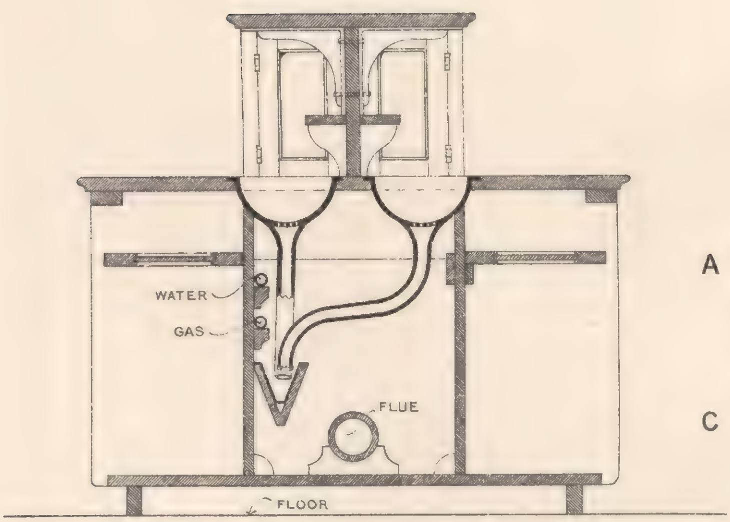


FIG. 6.
SECTION A.B.

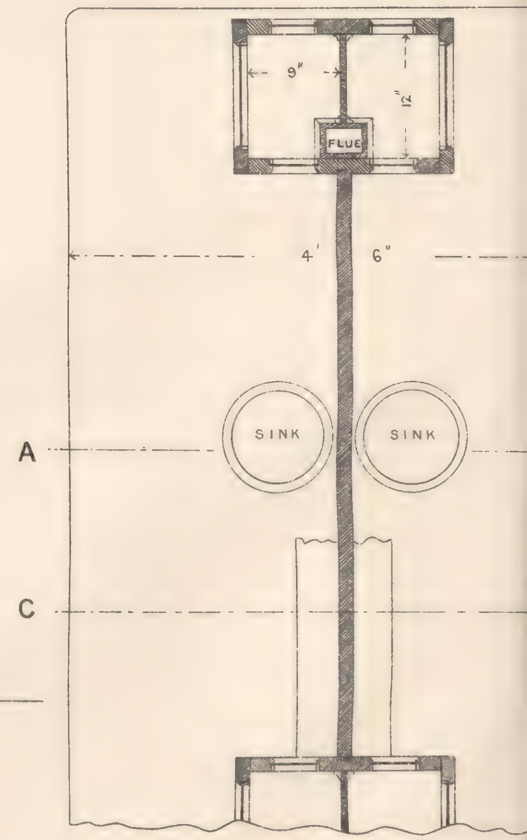
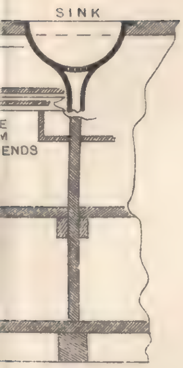


FIG. 7.
PART PLAN OF BENCH.



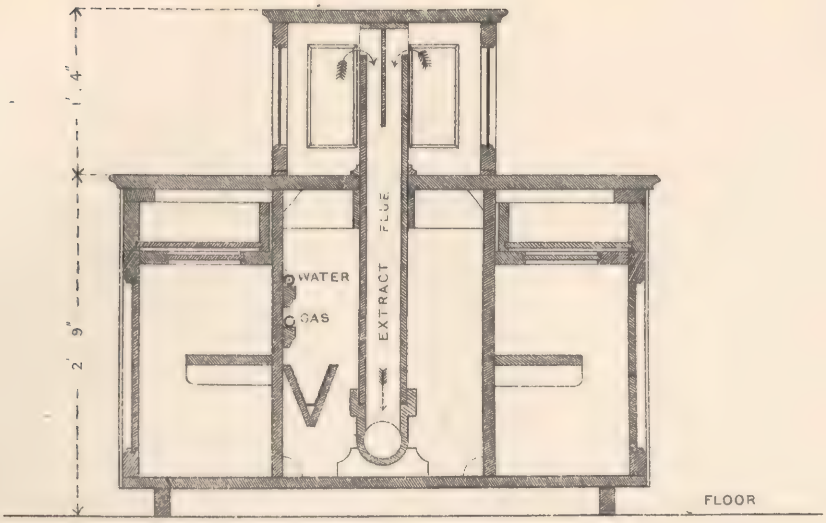


FIG. 5.
SECTION C.D.

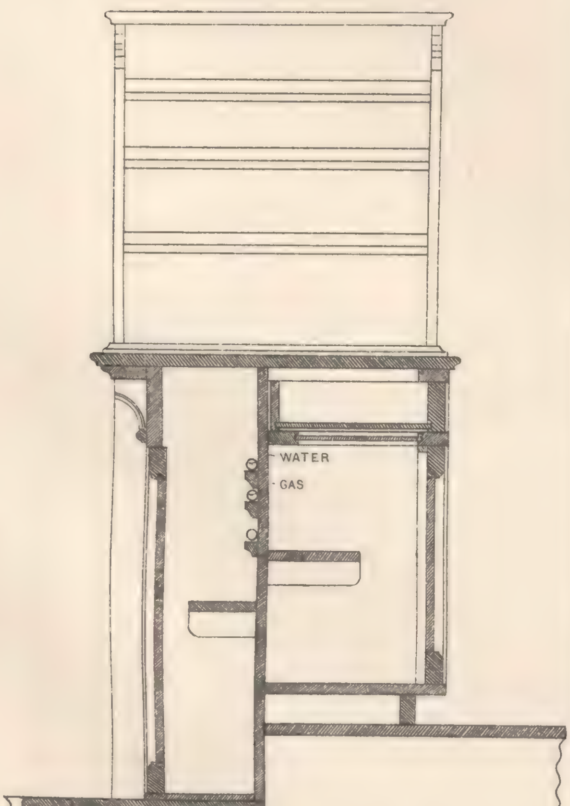
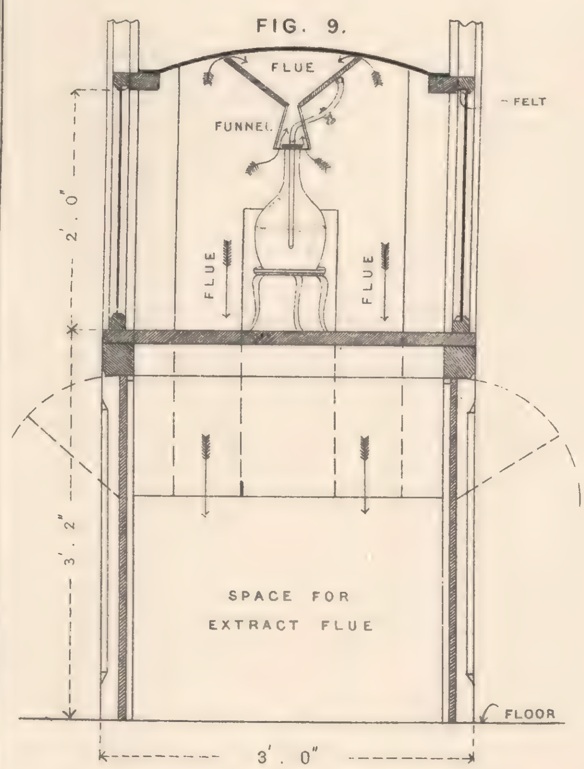


FIG. 8.
SECTION THROUGH LECTURER'S BENCH.

3 4 5 FEET

FINSBURY TECHNICAL COLLEGE.

FIG. 9.



SECTION THROUGH SULPHURETTED HYDROGEN CLOSET.

C.F.Kell, Photo-Litho. Castle St Holborn, London, E.C.

11, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS (iv).

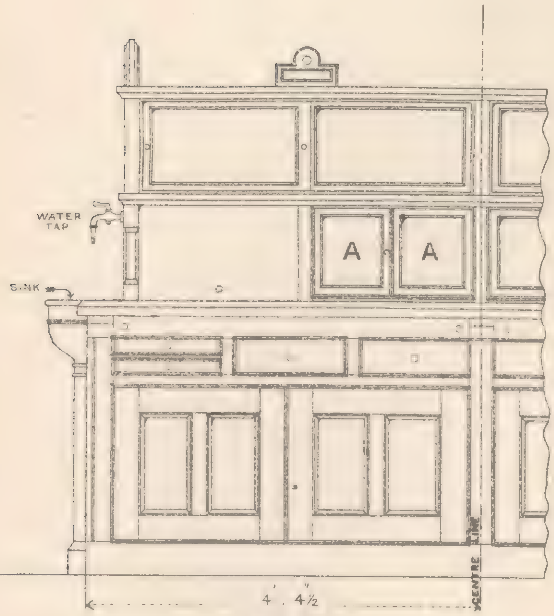


FIG. 10.
QUANTITATIVE TABLE
HALF FRONT ELEVATION.

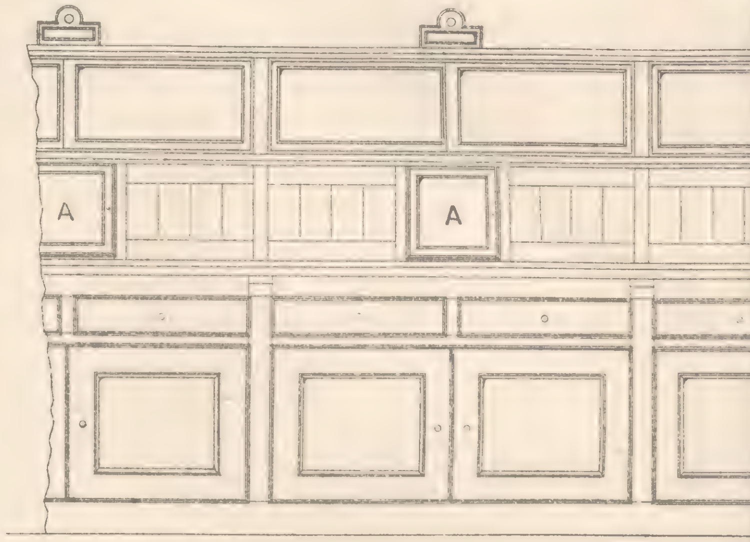


FIG.
QUALITATIVE TABLE, PA

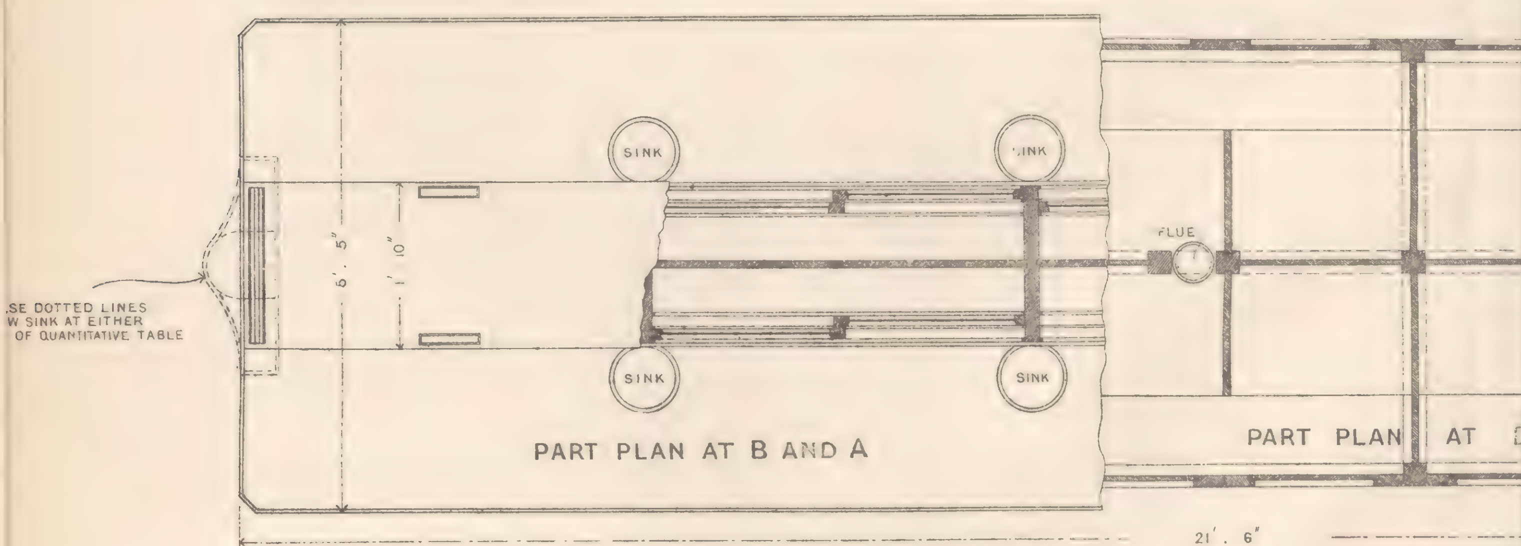
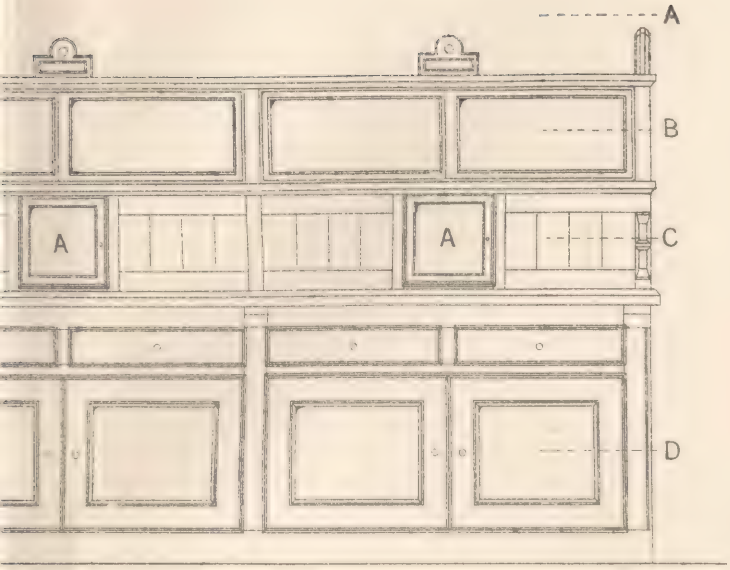


FIG. 13.
PLAN OF QUALITATIVE TABLE.

INS 12 6 0 1

OWENS COLLEGE, MANCHESTER.



...I.
...T FRONT ELEVATION.

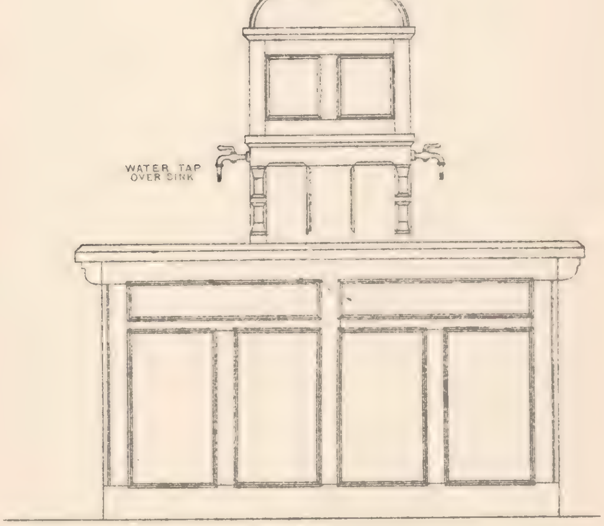
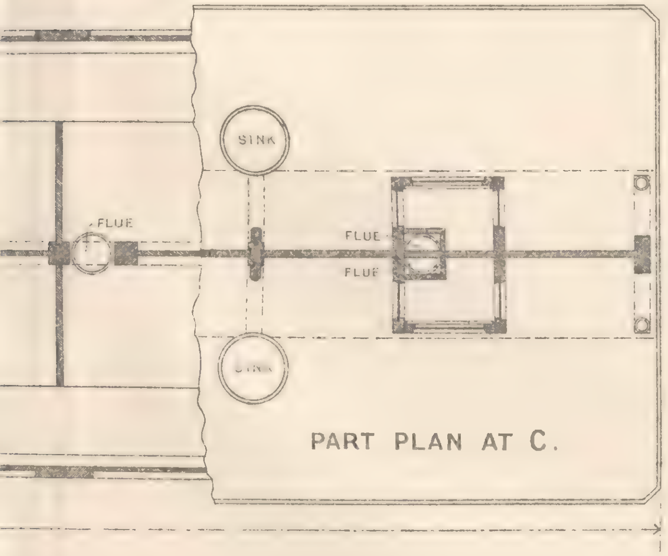


FIG. 12.
END ELEVATION OF QUALITATIVE TABLE



PART PLAN AT C.

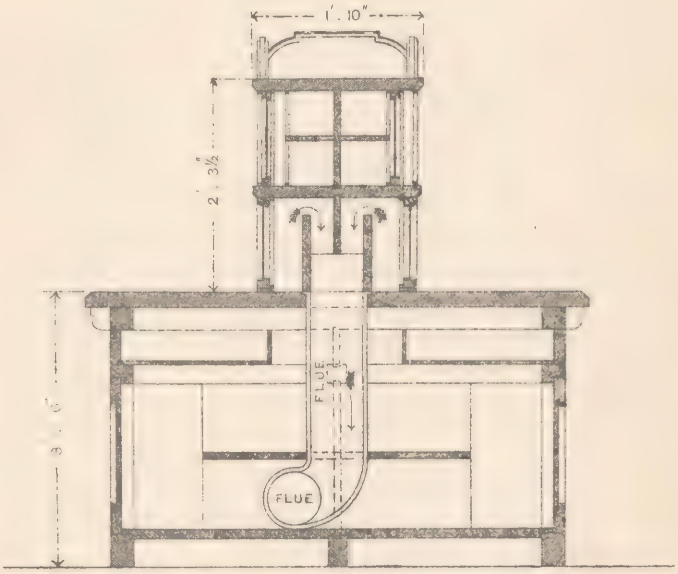


FIG. 14.
SECTION OF TABLES

...ALE
...2 3 4 5 FEET

C.F. Kell, Photo-Litho. Castle S^t Holborn, London, E.C

II, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS. (V)

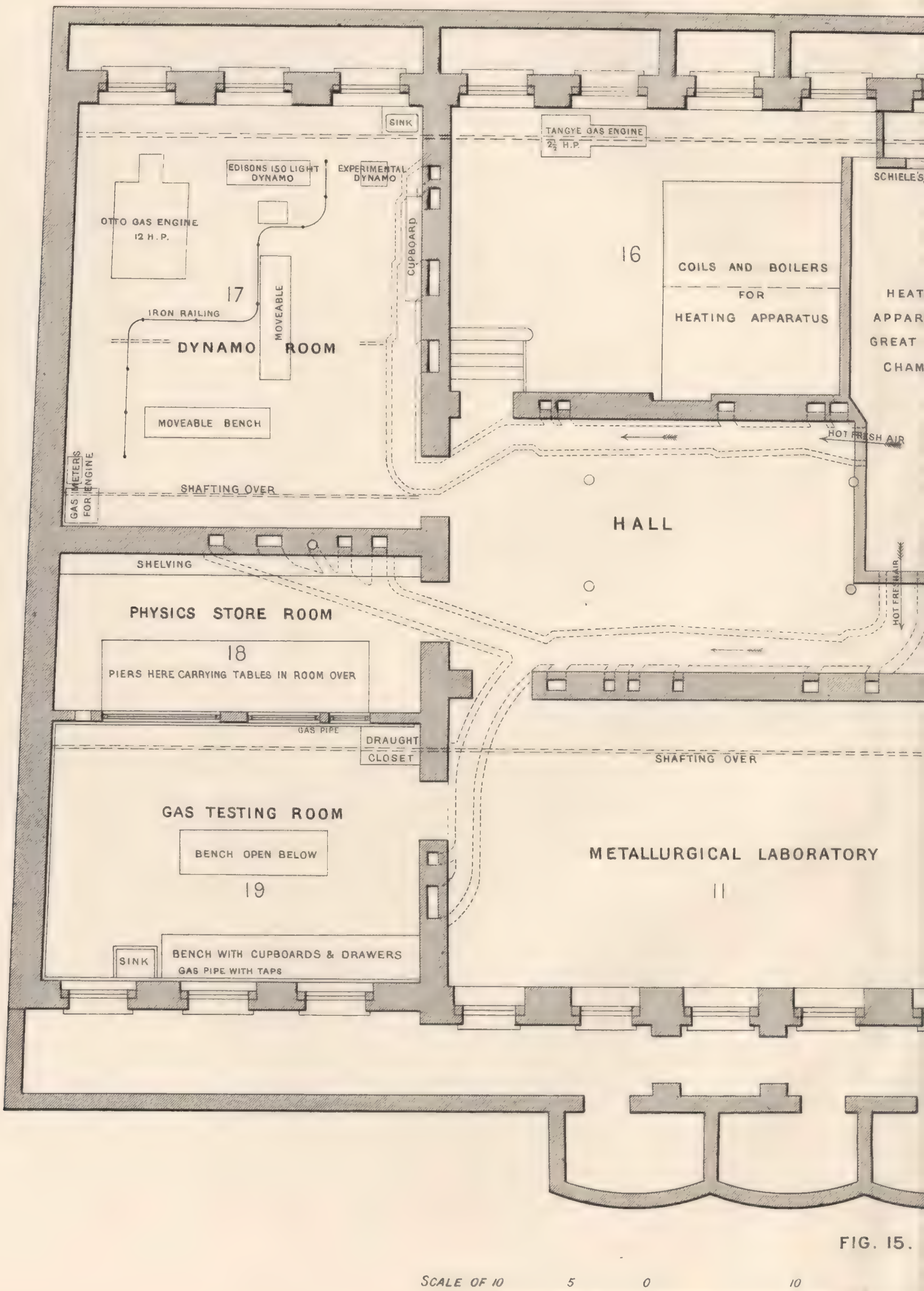
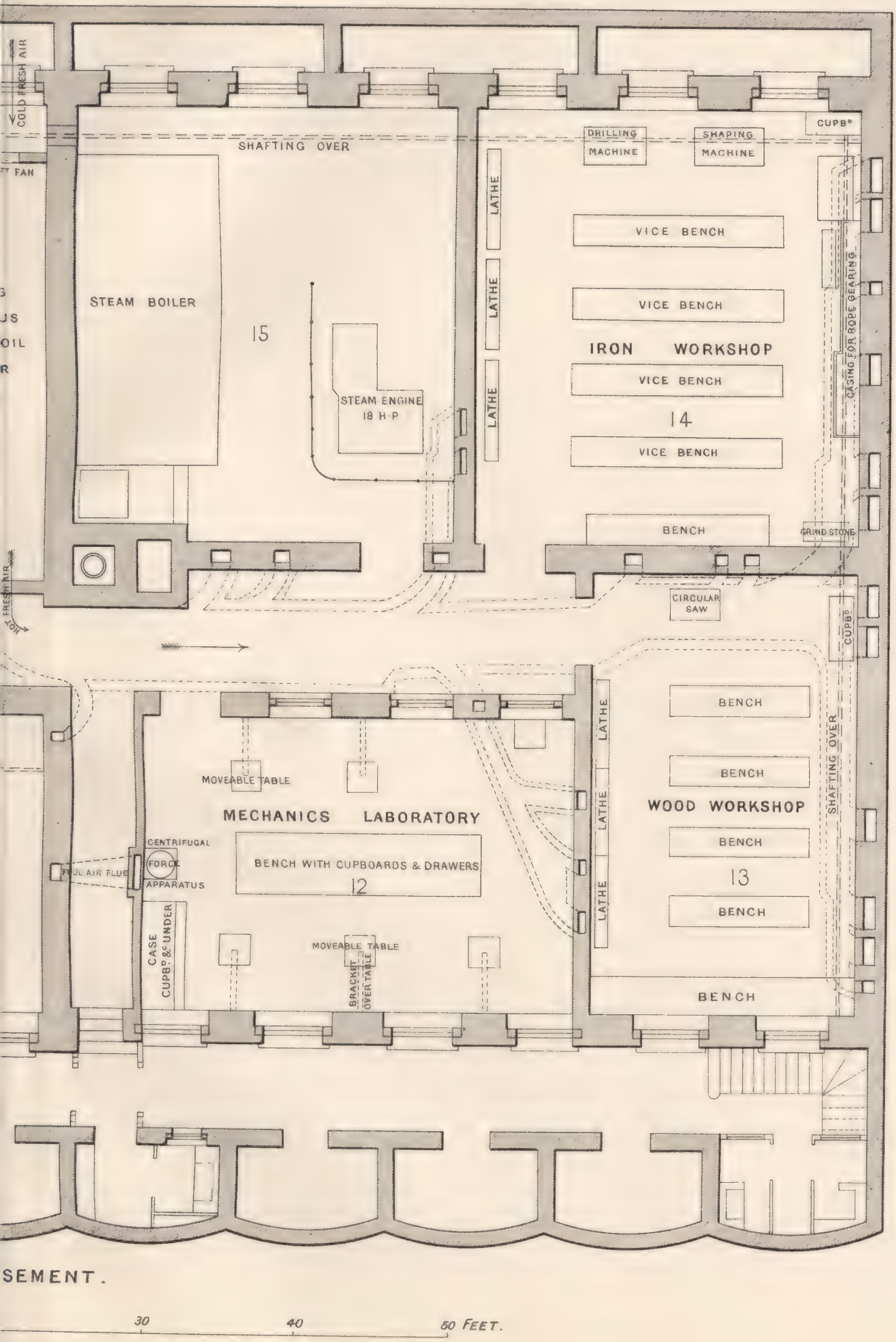


FIG. 15.

TECHNICAL COLLEGE, FINSBURY.



SEMENT.

F. Kell. Lith. 8, Castle St Holborn, London, E.C.

II, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS (VI)

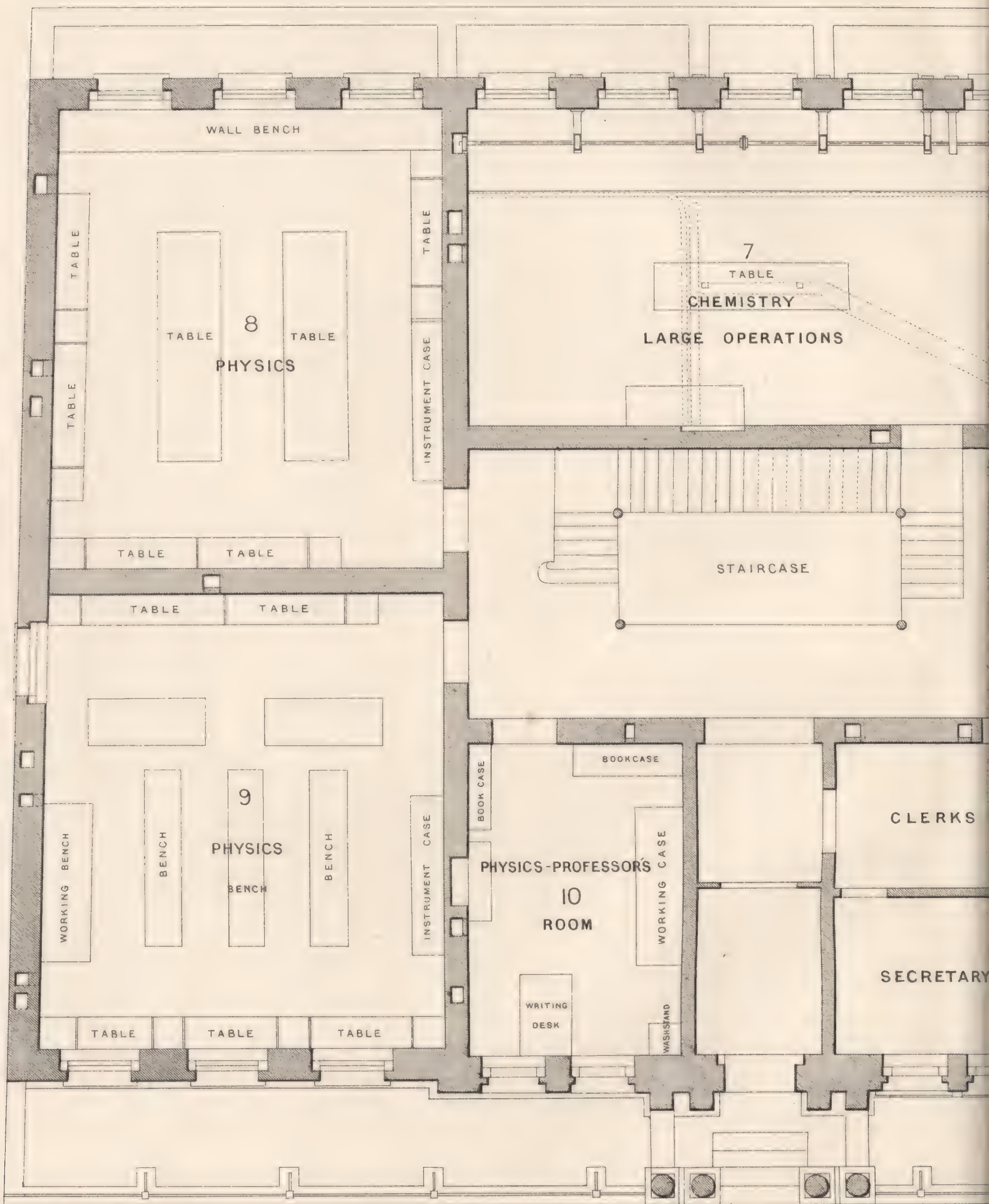


FIG. 16. GROUND FL

SCALE OF 10 5 0 10 20

TECHNICAL COLLEGE, FINSBURY

OR PLAN.

30 40 50 FEET

C. F. Kell. Lith 8. Castle St. Holborn. London. E.C.

II, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS.(vii)

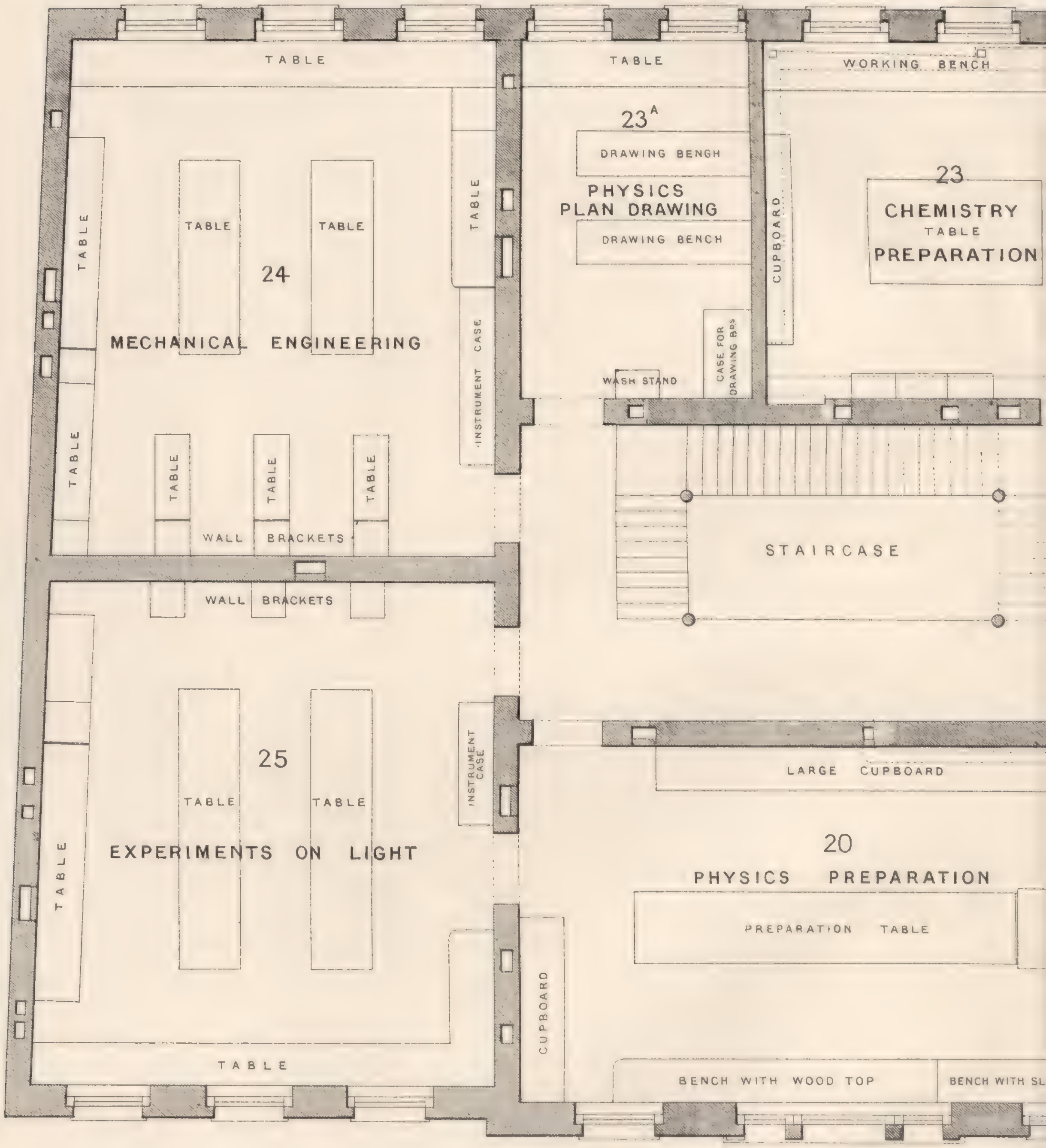


FIG. 17. FIR

SCALE OF 10 5 0 10

TECHNICAL COLLEGE, FINSBURY.

FLOOR PLAN.

30 40 50 FEET.

F Kell Lith 8 Castle St Holborn London E.C.

11, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS.(viii)

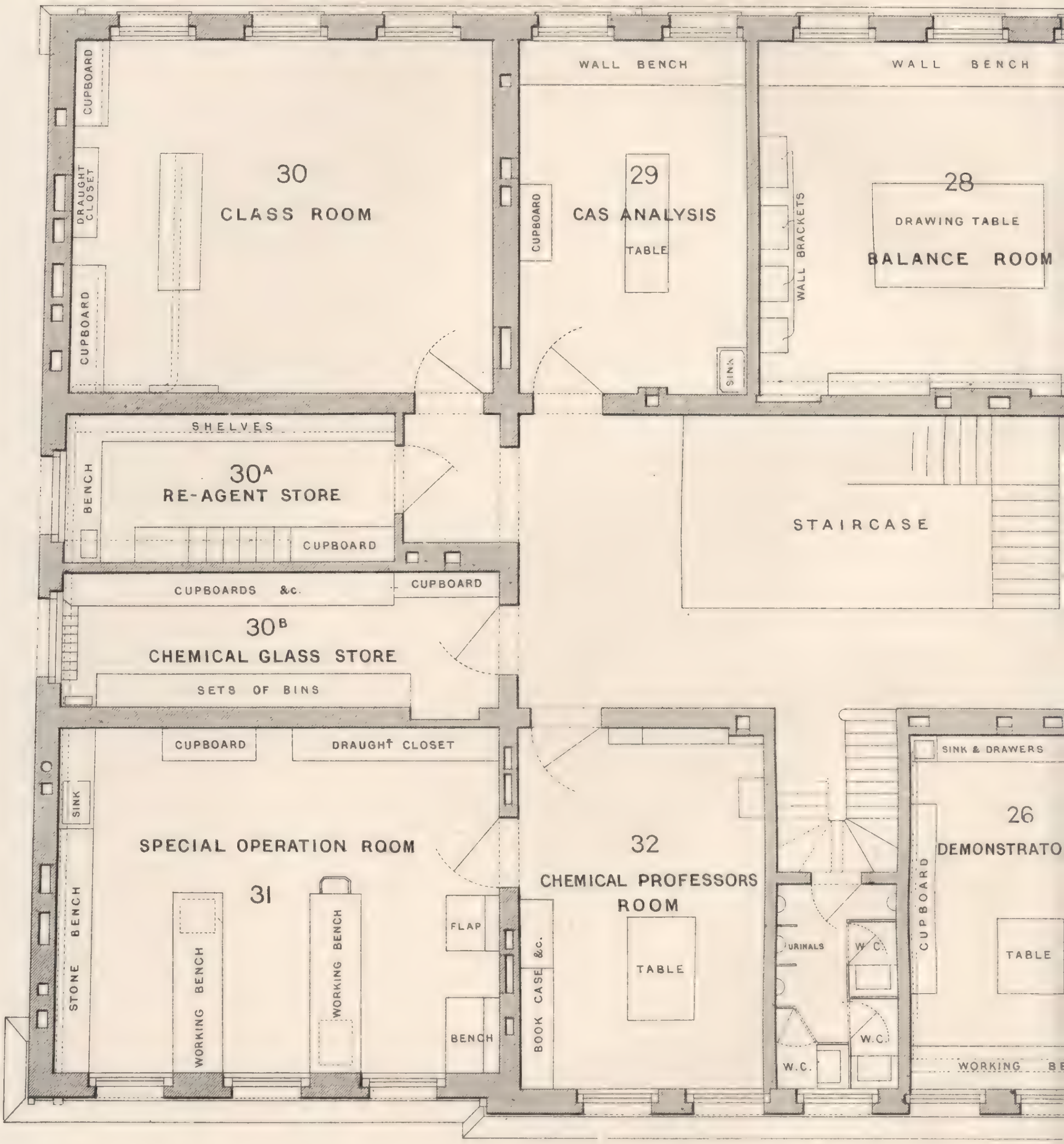
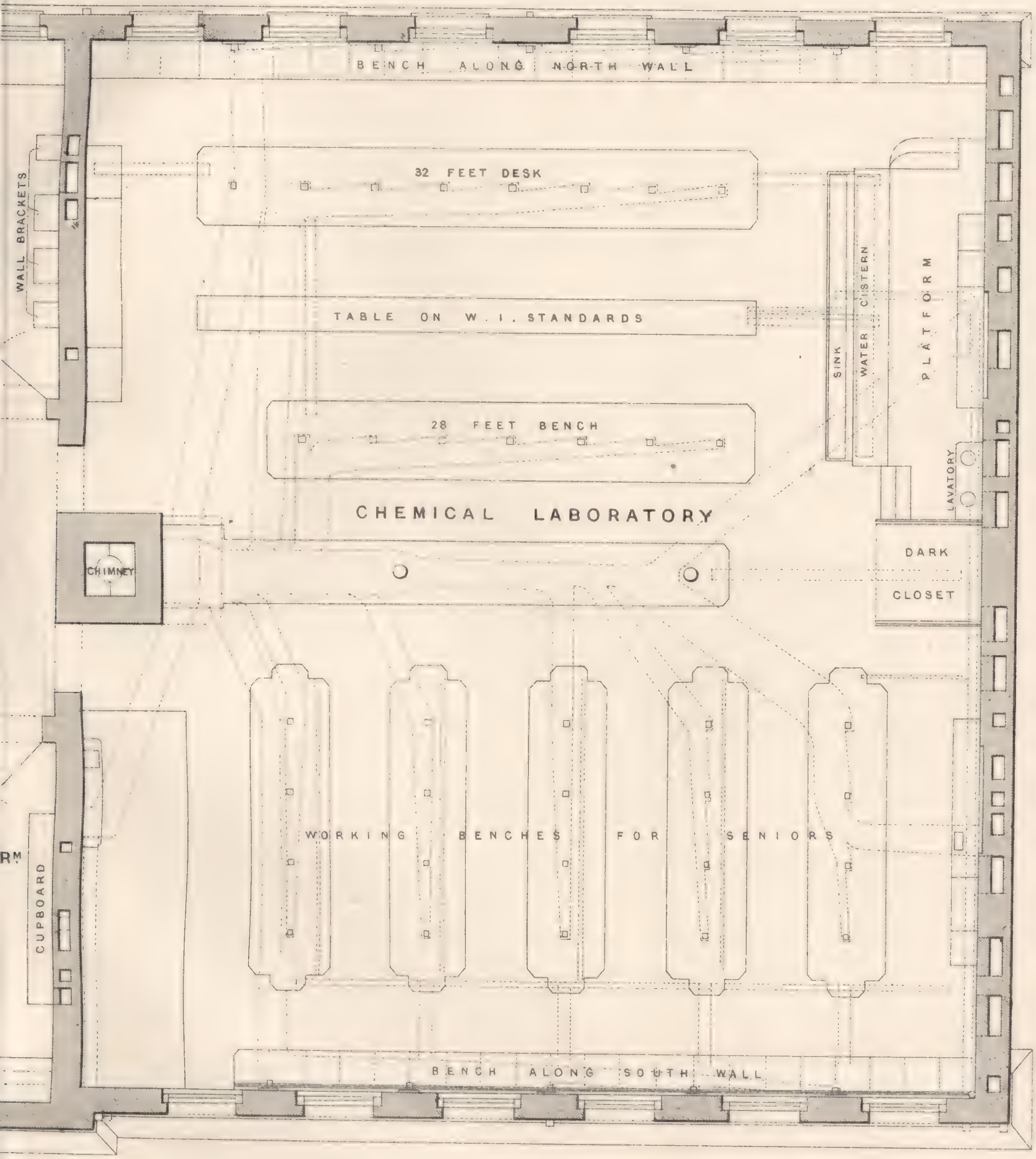


FIG. 18. SECOND

SCALE OF 10 5 0 10 20

TECHNICAL COLLEGE, FINSBURY.



OOR PLAN.

30 40 60 FEET.

C. F. Kell, Lith. 8, Castle St. Holborn, London, E.C.

11, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS (ix)

TECHNICAL CO

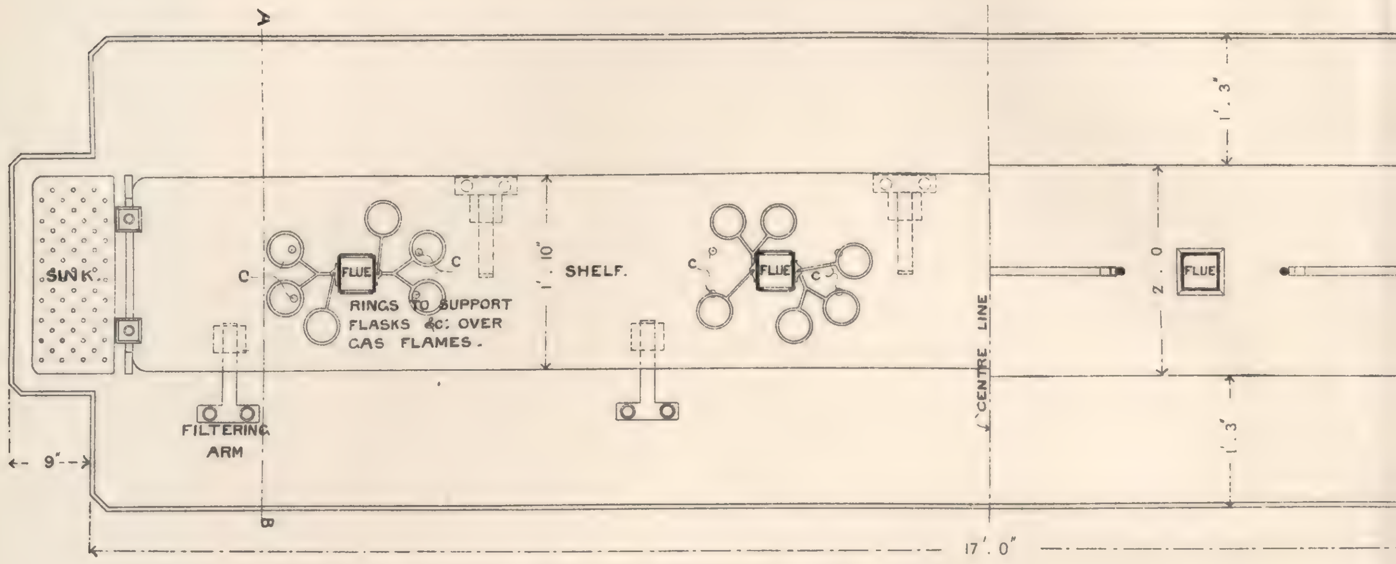


FIG. 19. HALF PLAN AT LEVEL ✕

FIG. 20

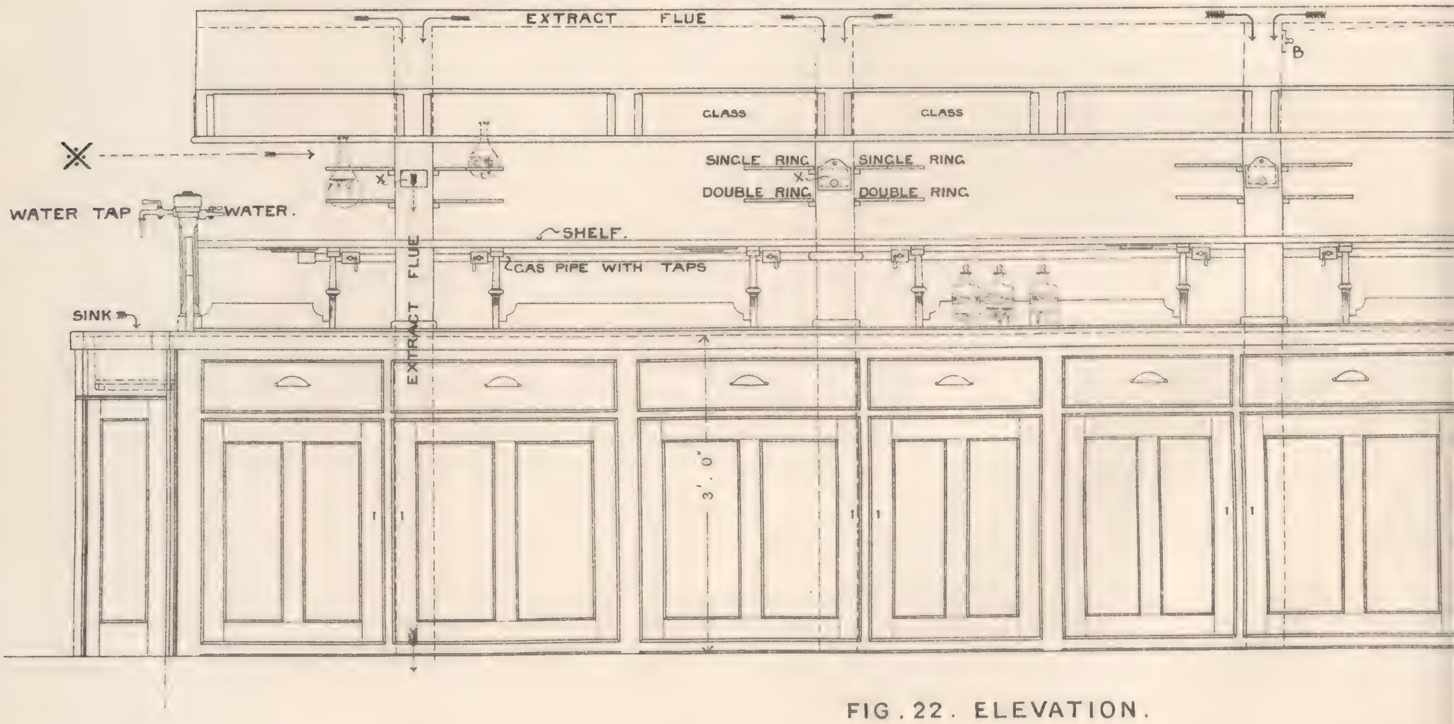


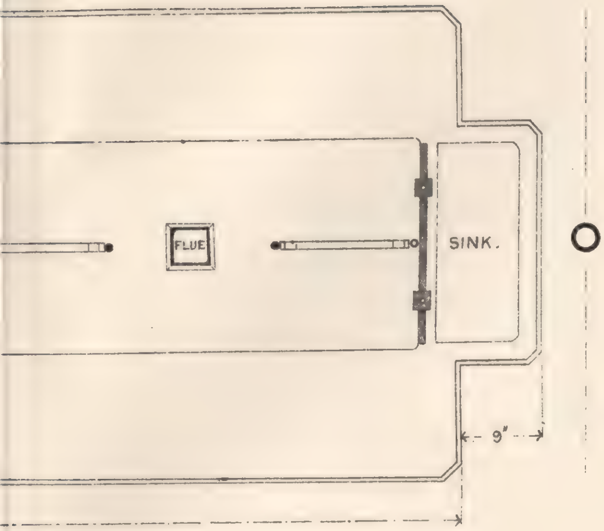
FIG. 22. ELEVATION.

SCALE.

INS 12 6 0 1 2 3 4 5 FEET.

STUDENTS' BENCH WITH

EGE, FINSBURY.



HALF PLAN AT LEVEL ⊗

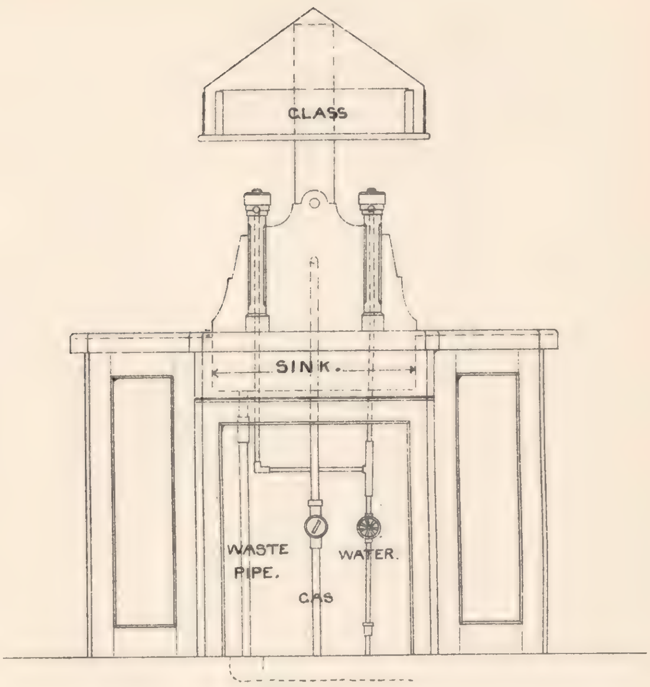
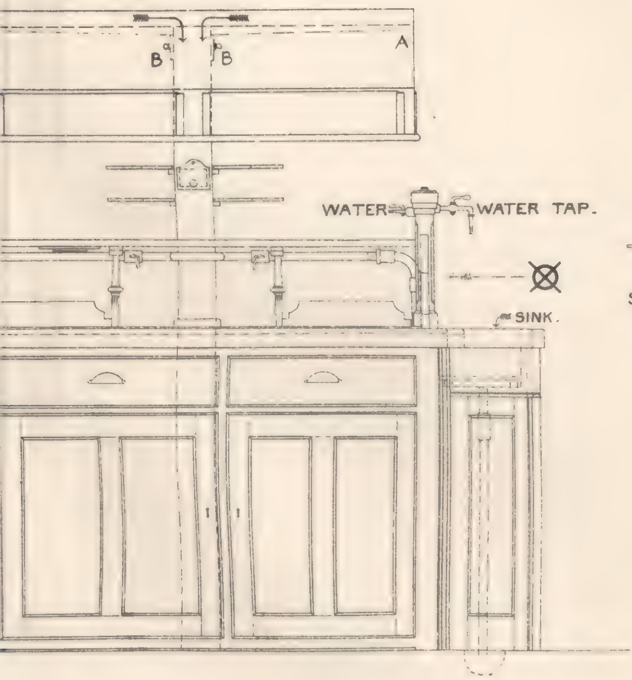
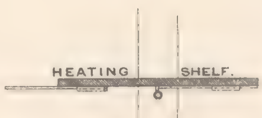


FIG. 21.
END ELEVATION.





SHEWING SLIDING BRACKETS.
FIG. 23

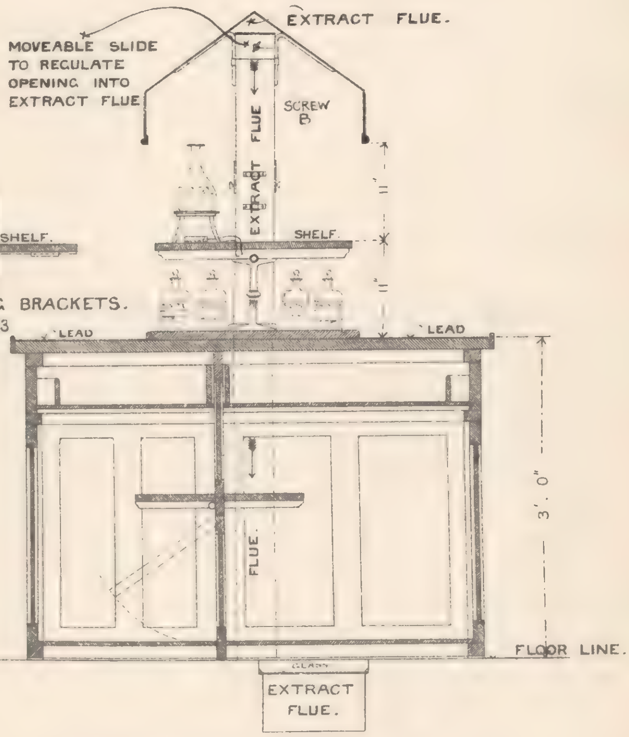


FIG. 24. SECTION A. B.

PROF. ARMSTRONG'S HOOD.

C.F. Kell, Photo-Litho. Castle St Holborn, London, E.C.

11, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS (X)

TECHNICAL COLLECE, FINSBURY.

DEMONSTRATION TABLE & STUDENTS SUITS IN THE LARGE LABORATORY

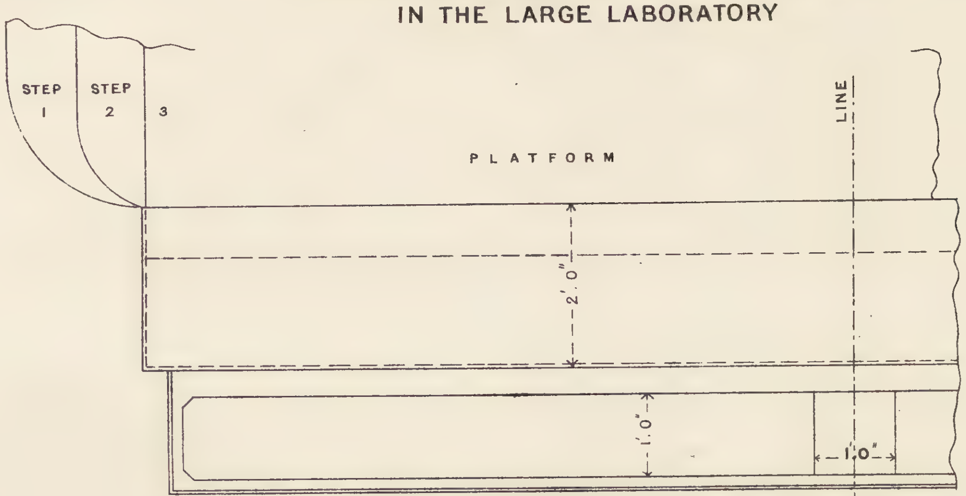


FIG. 25
HALF PLAN

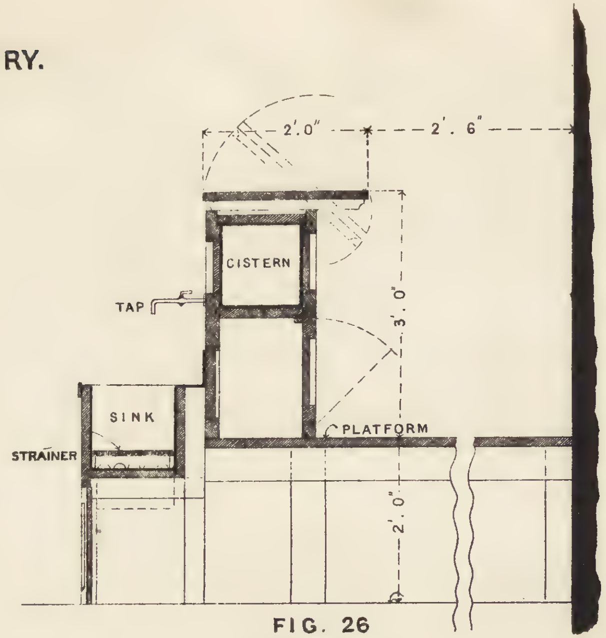


FIG. 26
SECTION.

SCALE
INS 12 6 0 1 2 3 4 5 FEET

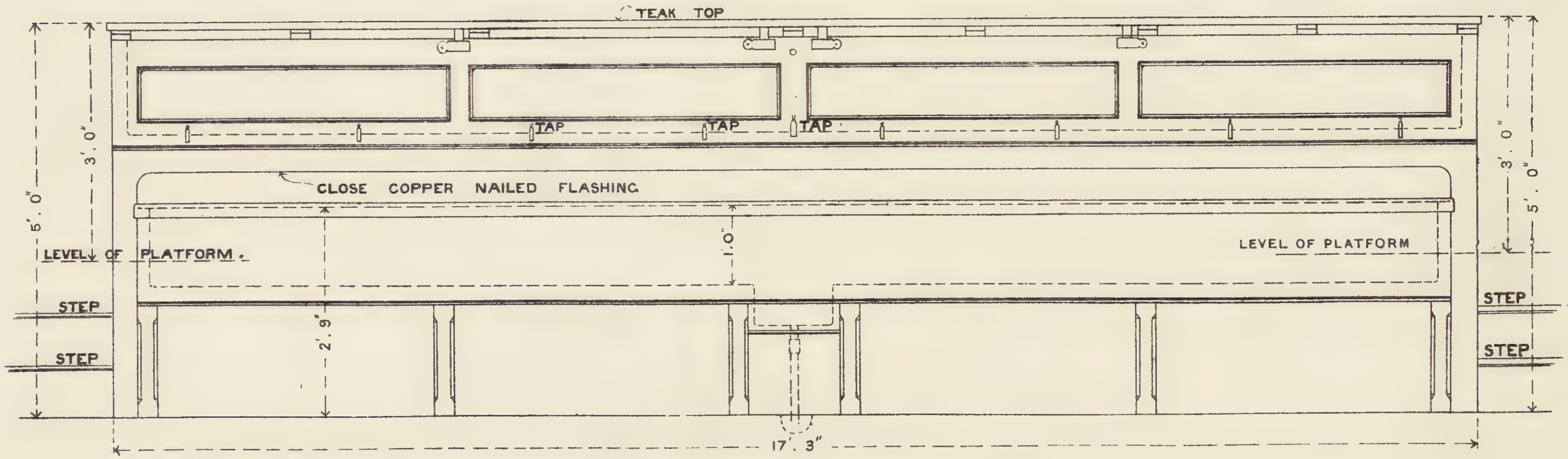


FIG. 27. ELEVATION.

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II, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS. (xi)

TECHNICAL COLLEGE, FINSBURY.

SCALE.

INS 12 6 0 1 2 3 4 5 FEET

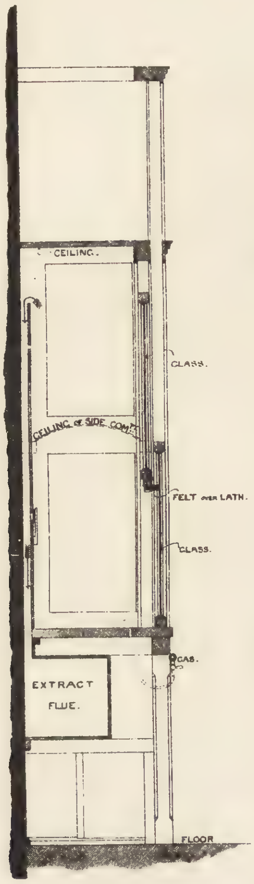

FIG. 28.
SECTION A.B.

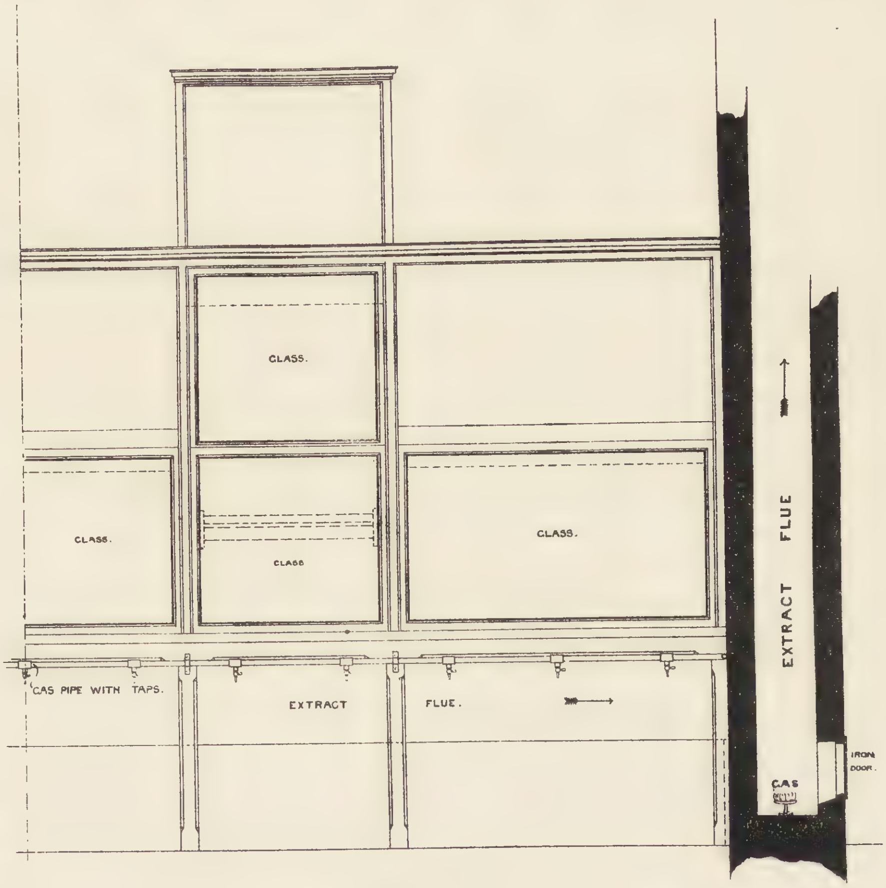

FIG. 29. ELEVATION.

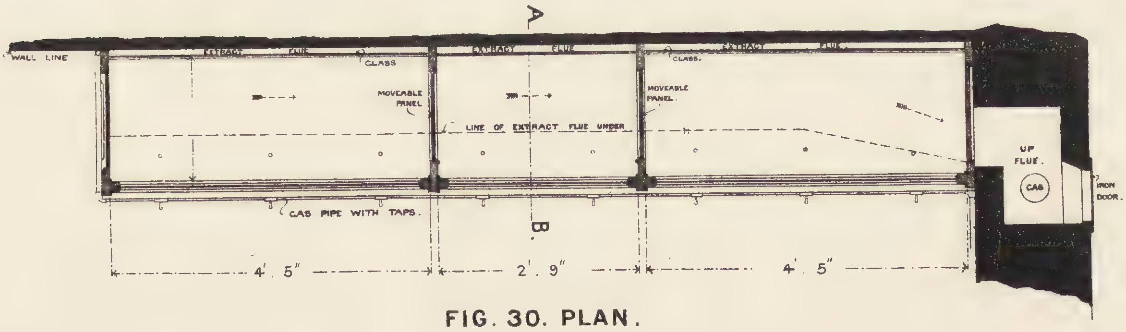

FIG. 30. PLAN.

DRAUGHT CLOSETS IN PRIVATE LABORATORY.

C.F. Kell, Photo-Litho. Castle St Holborn, London, E.C.

TECHNICAL COLLEGE, FINSBURY.

II. FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS (xii)

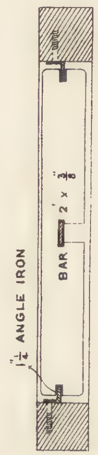

FIG. 31. PLAN THRO COUNTER WEIGHT

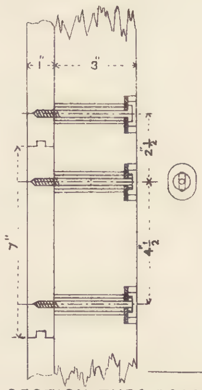

FIG. 32. PART SECTION THRO BOARD

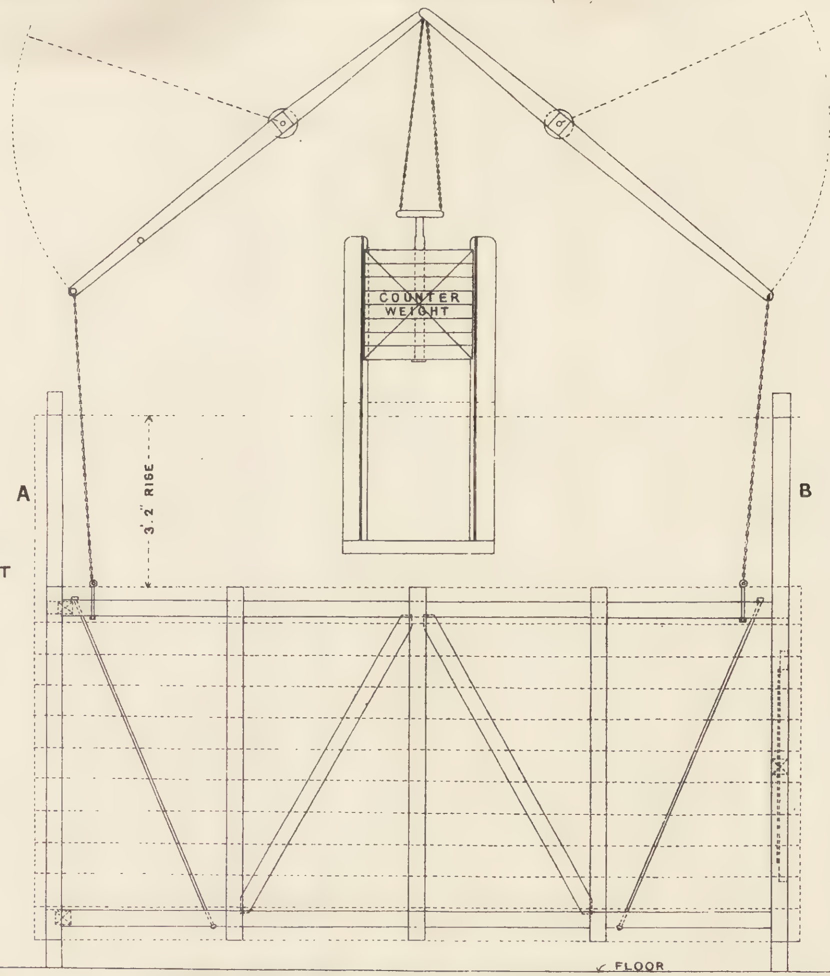

FIG. 33. ELEVATION SHEWING FRAMING &c.

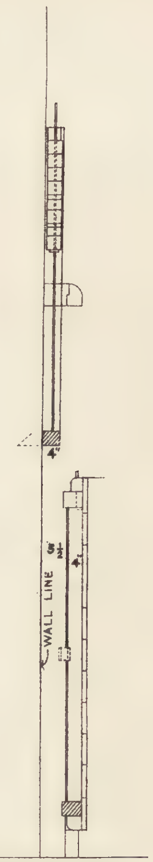

FIG. 34. SECTION

FIG. 35. DETAIL PLAN AT C

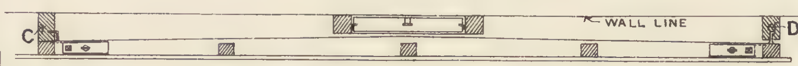

FIG. 36. PLAN AT LEVEL A.B.

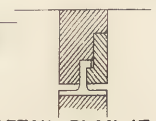

FIG. 37. DETAIL PLAN AT D

SCALE OF 0 1 2 3 4 5 6 7 8 FEET

BLACK BOARD

Designed by Prof. James Thompson, Glasgow.

C. F. Kell. Lith. 8, Castle St. Holborn, London, E.C.

11, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS. (xiii)

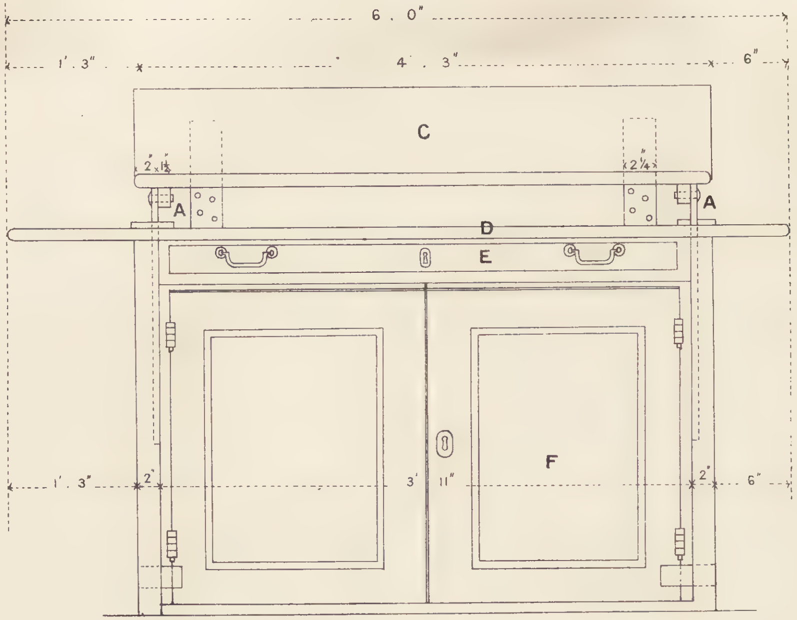

FIG. 38. ELEVATION OF DRAWING BENCH

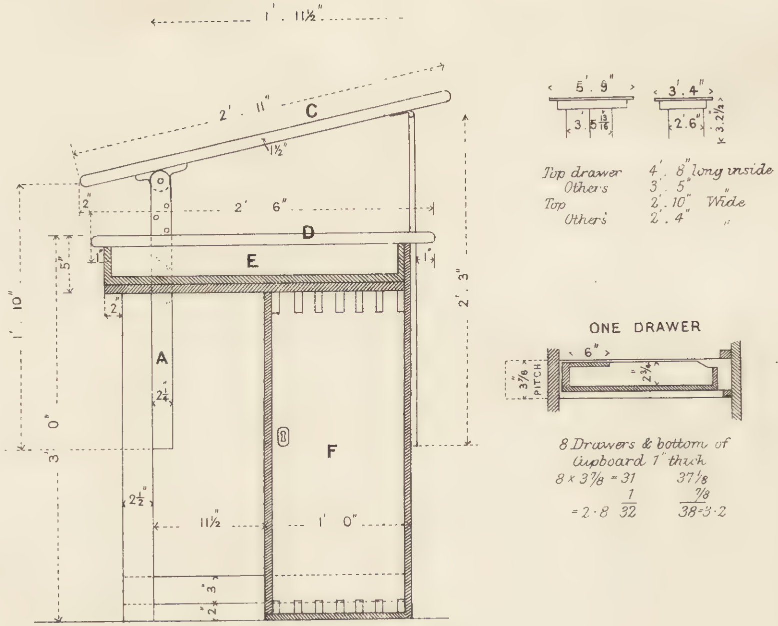

FIG. 39. SECTION OF DRAWING BENCH.

FINSBURY COLLEGE.

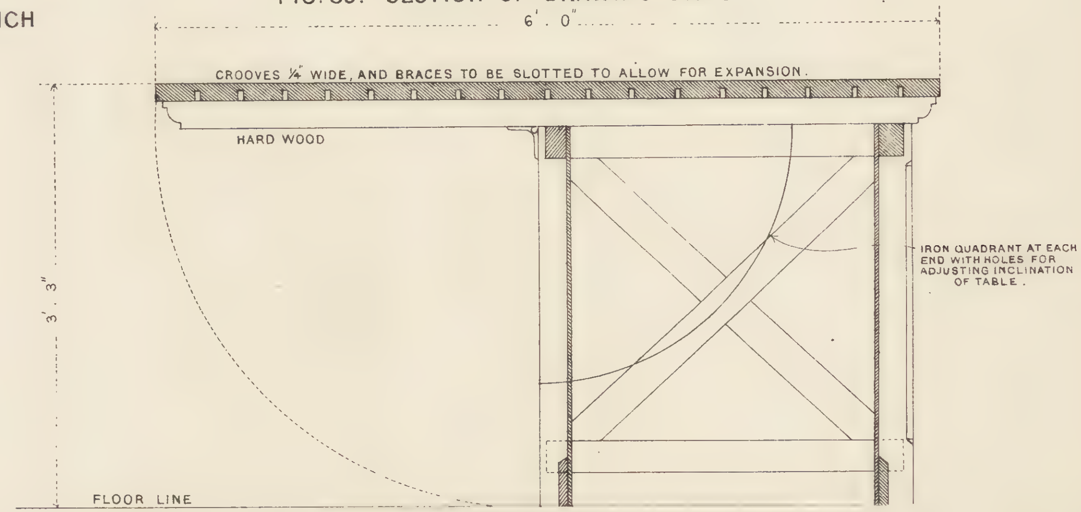

FIG. 40. SECTION OF DIAGRAM TABLE IN BALANCE ROOM.

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11. FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS (XIV)

UNIVERSITY COL

DETAILS OF L

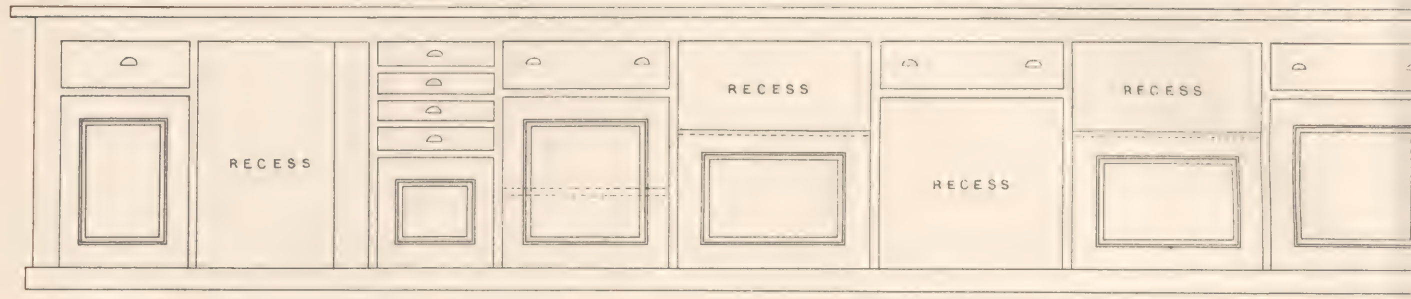


FIG. 41. BACK ELEVATION. PITCH PINE FRONTS.

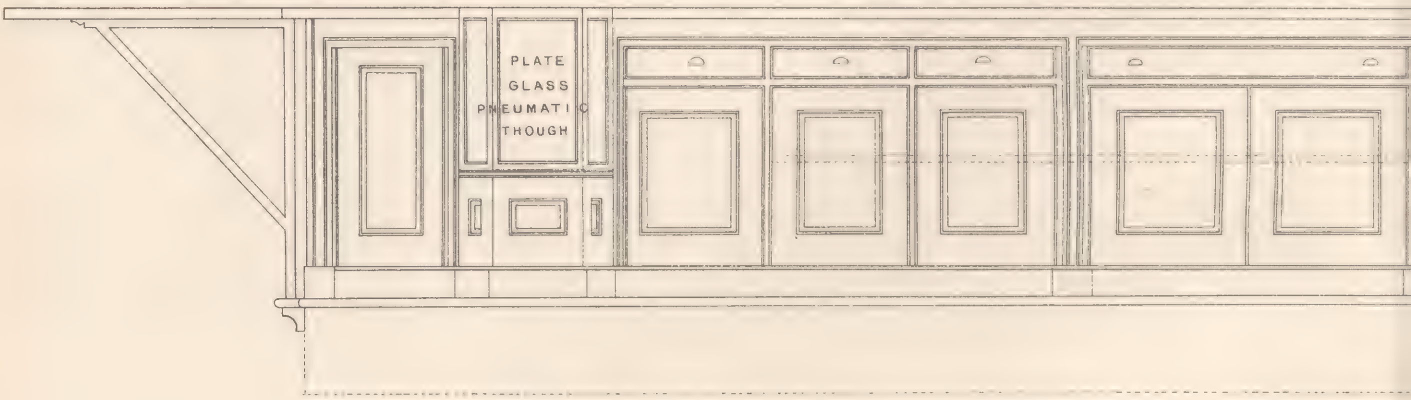


FIG. 44. FRONT ELEVATION. P

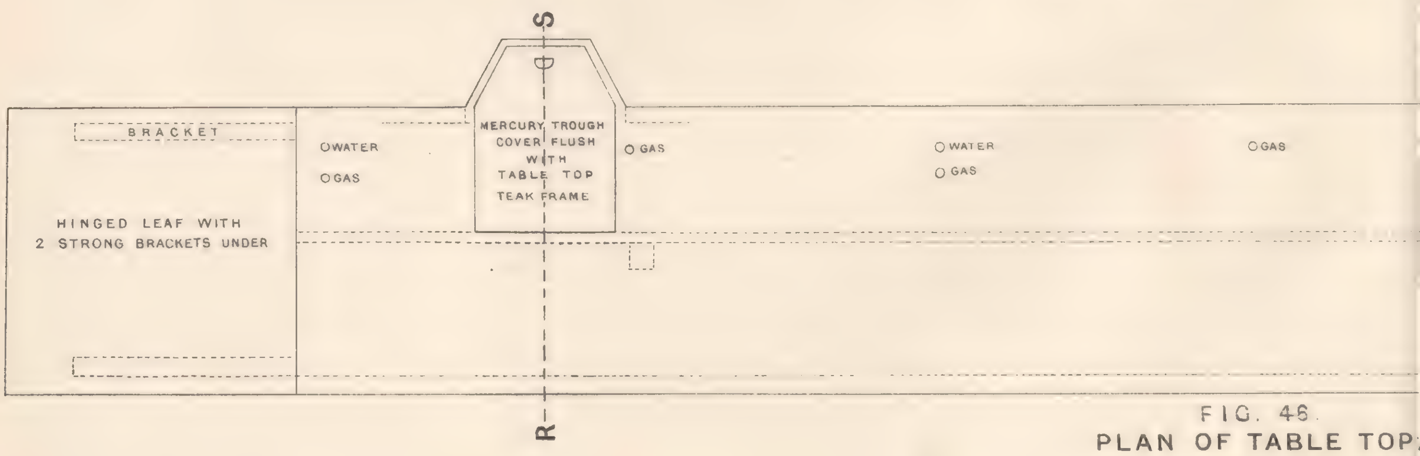
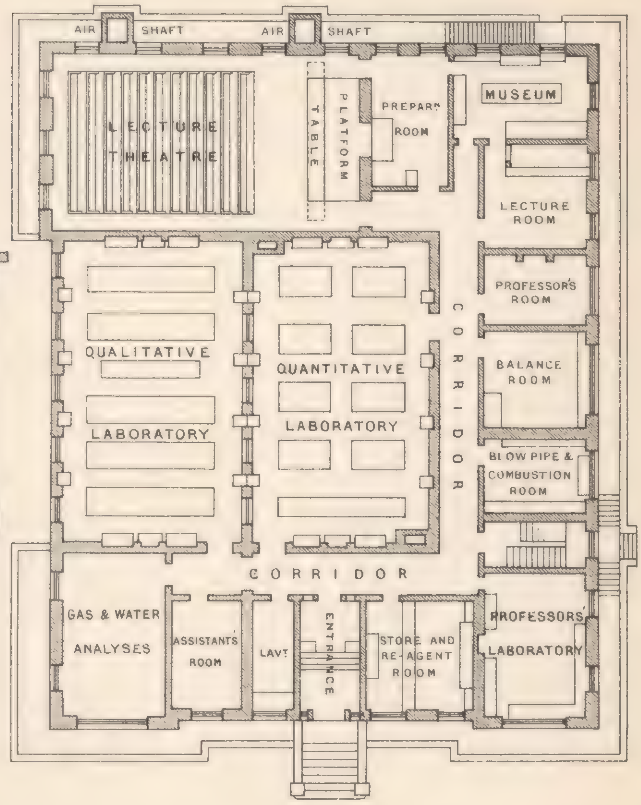


FIG. 46.
PLAN OF TABLE TOP:

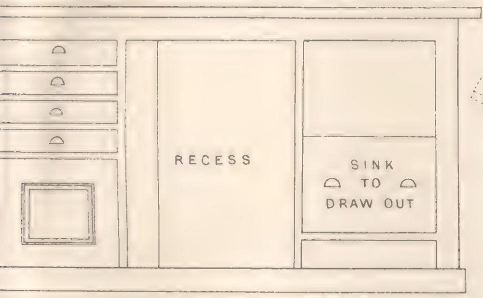
FIG. 43.

SKETCH PLAN OF UNIVERSITY COLLEGE, DUNDEE.



EGE DUNDEE; CHEMICAL LABORATORY,

CTURE TABLE IN LECTURE THEATRE.



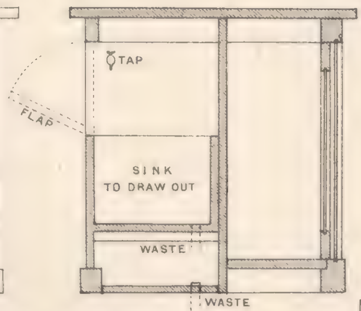
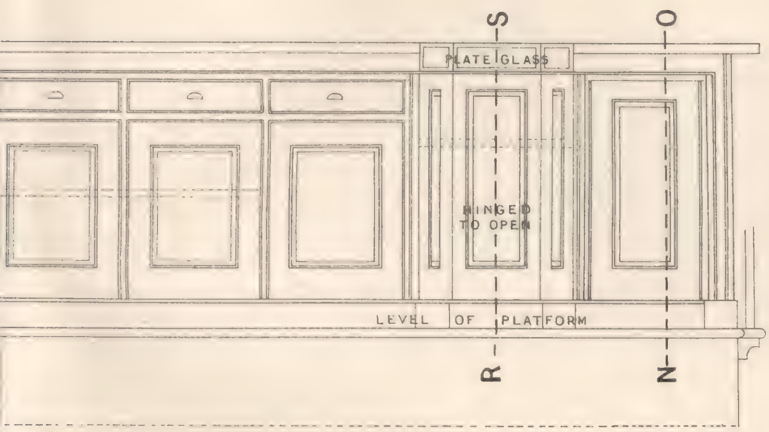


FIG. 42. SECTION N.O.



H PINE FRONTS.

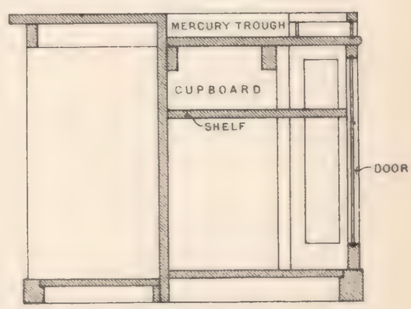
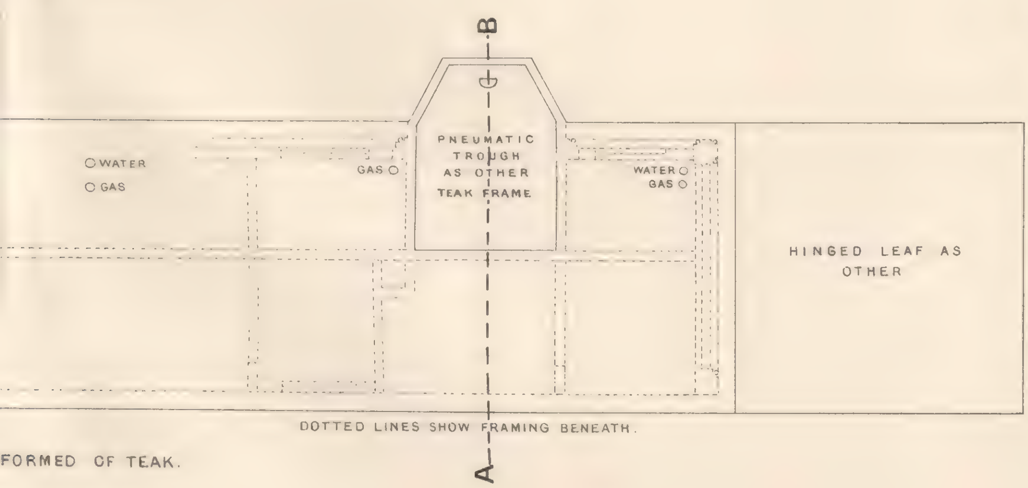


FIG. 45

SECTION R.S.



DOTTED LINES SHOW FRAMING BENEATH.

FORMED OF TEAK.

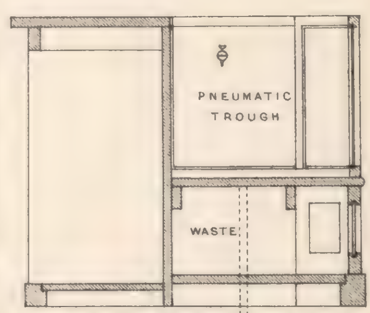


FIG. 47.

SECTION A.B.

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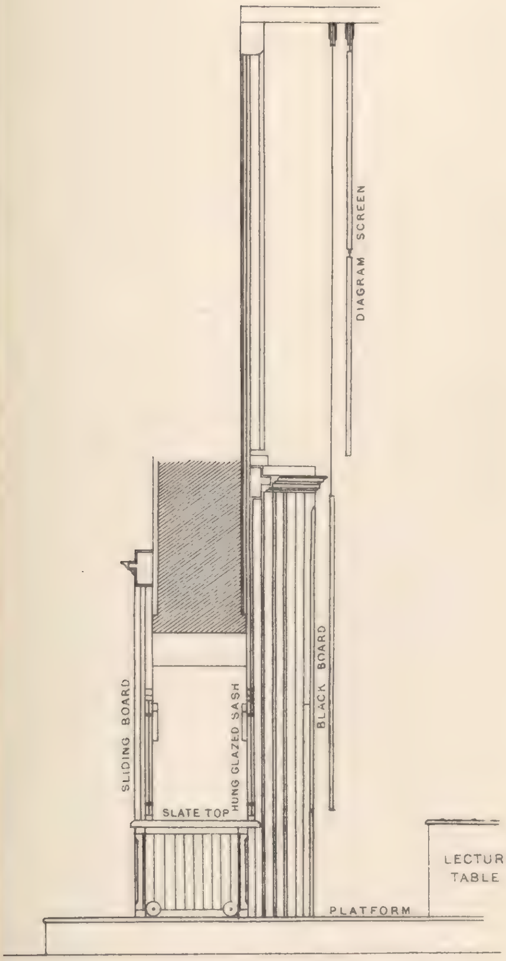
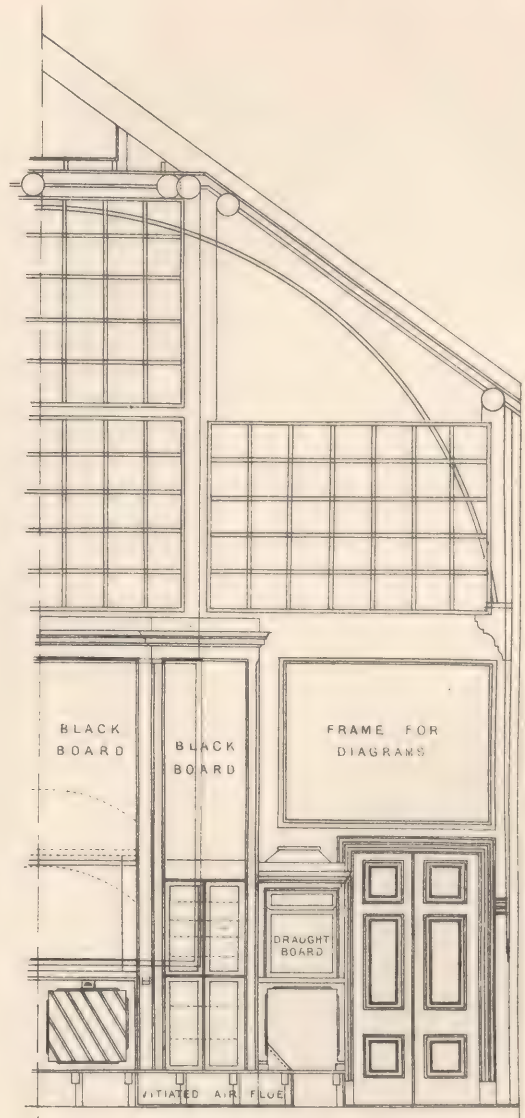
11, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS (XV).



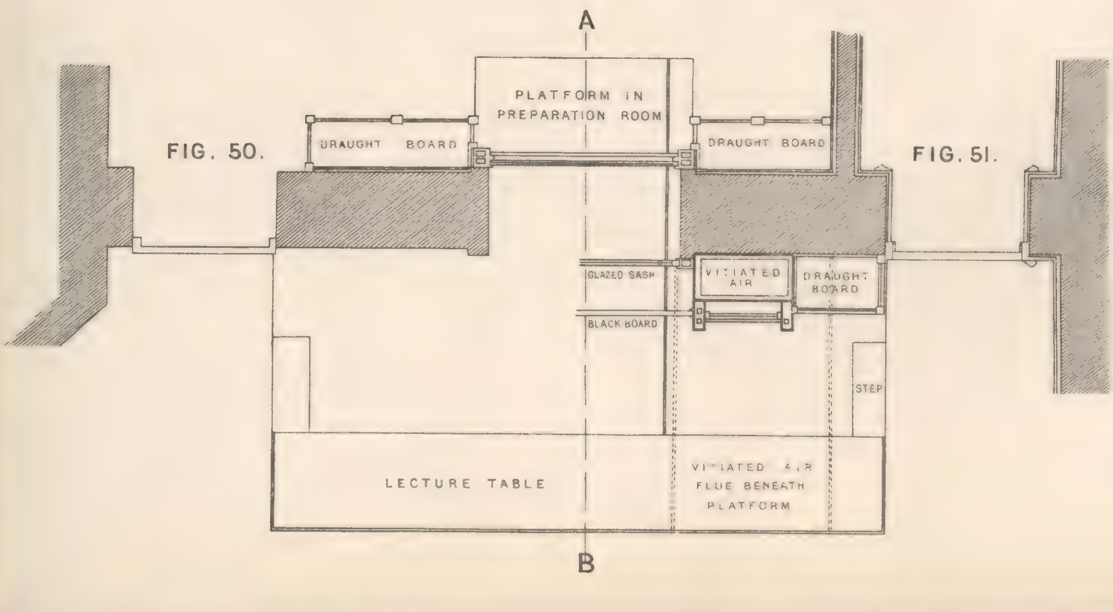
SECTION THRO' A.B.
FIG. 48.



HALF ELEVATION OF LECTURE ROOM.
FIG. 49.

FIG. 50.

FIG. 51.



UNIVERSITY COLLEGE DUNDEE; CHEMICAL LABORATORY.

STUDENTS' WORKING TABLES.

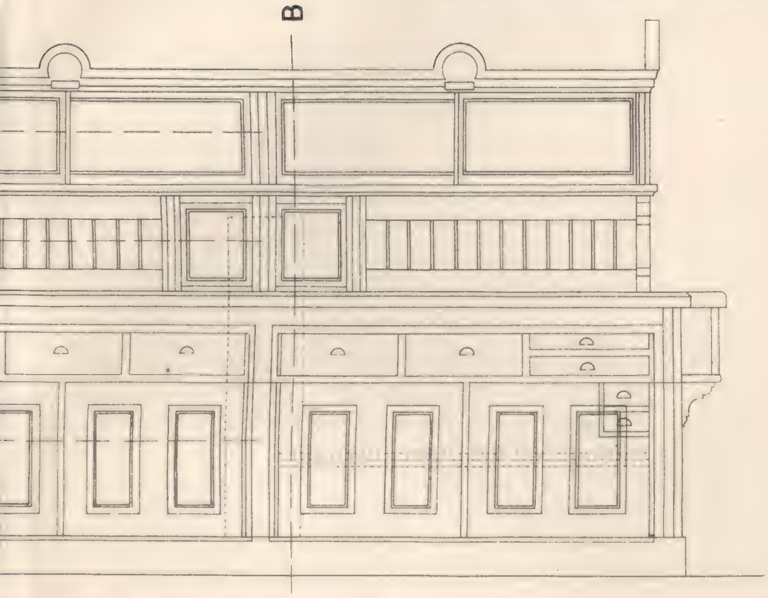


FIG. 52. ELEVATION.

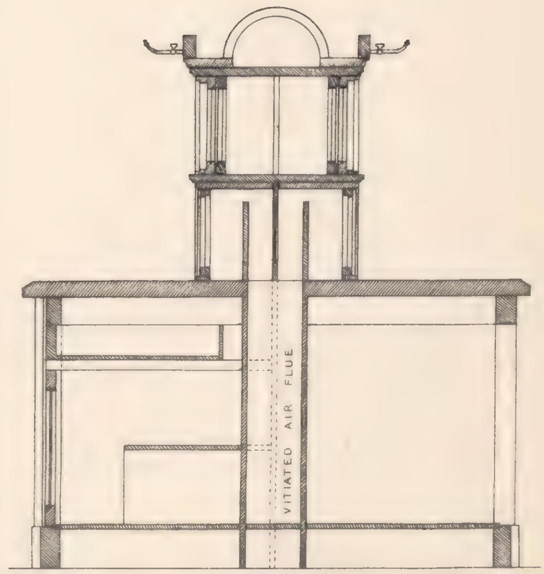


FIG. 53.
SECTION ON A.B.

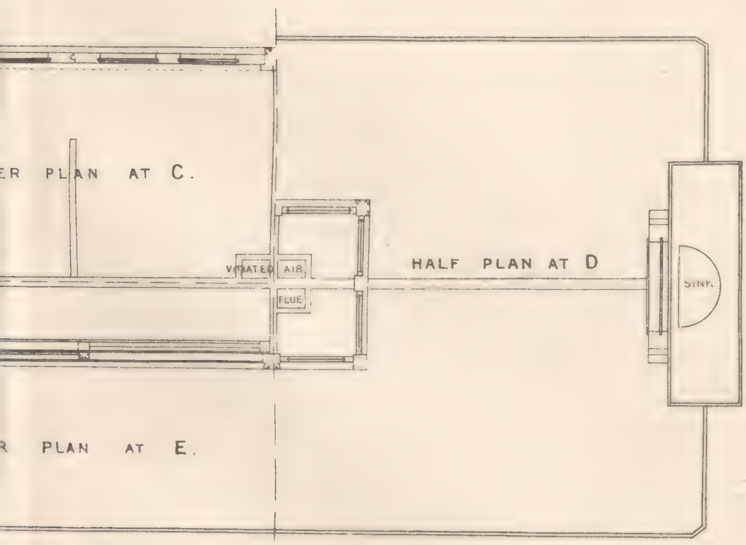


FIG. 54. PLAN.

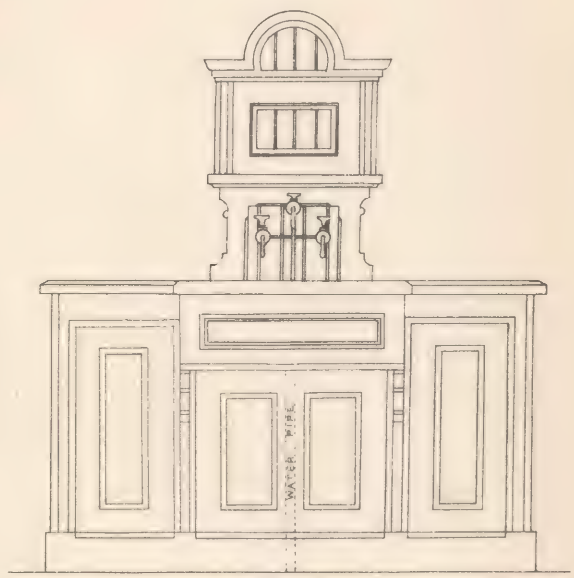


FIG. 55.
END ELEVATION OF SAME.

Edwd C. Robins

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11, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS. (XVI)

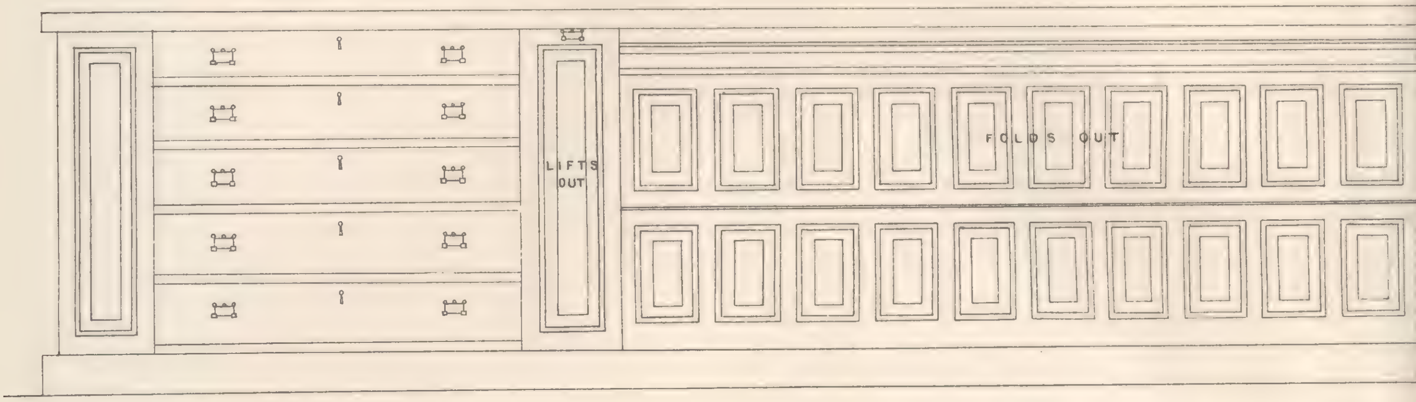


FIG. 56. FRONT OF TABLE.

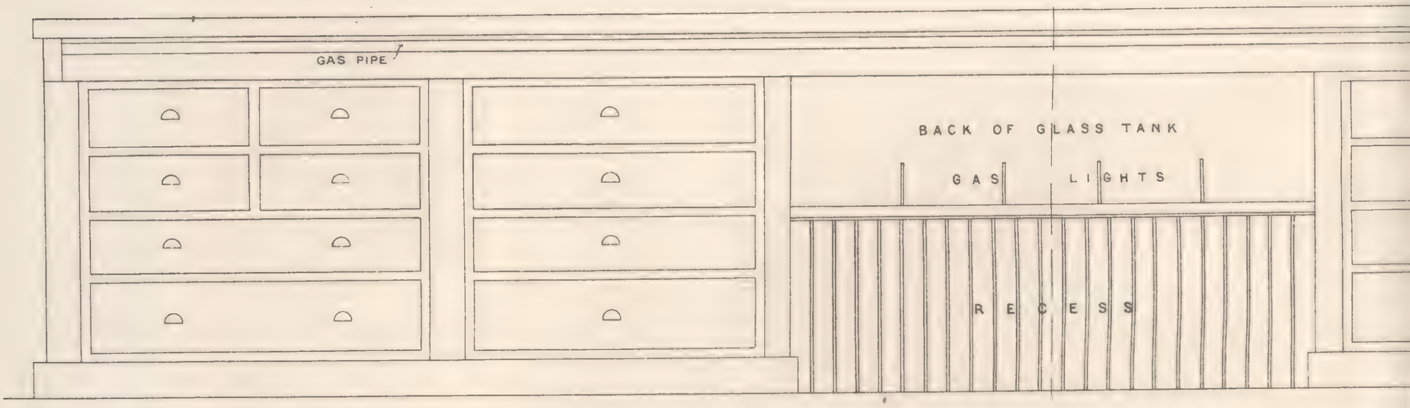


FIG. 58. BACK OF TABLE.

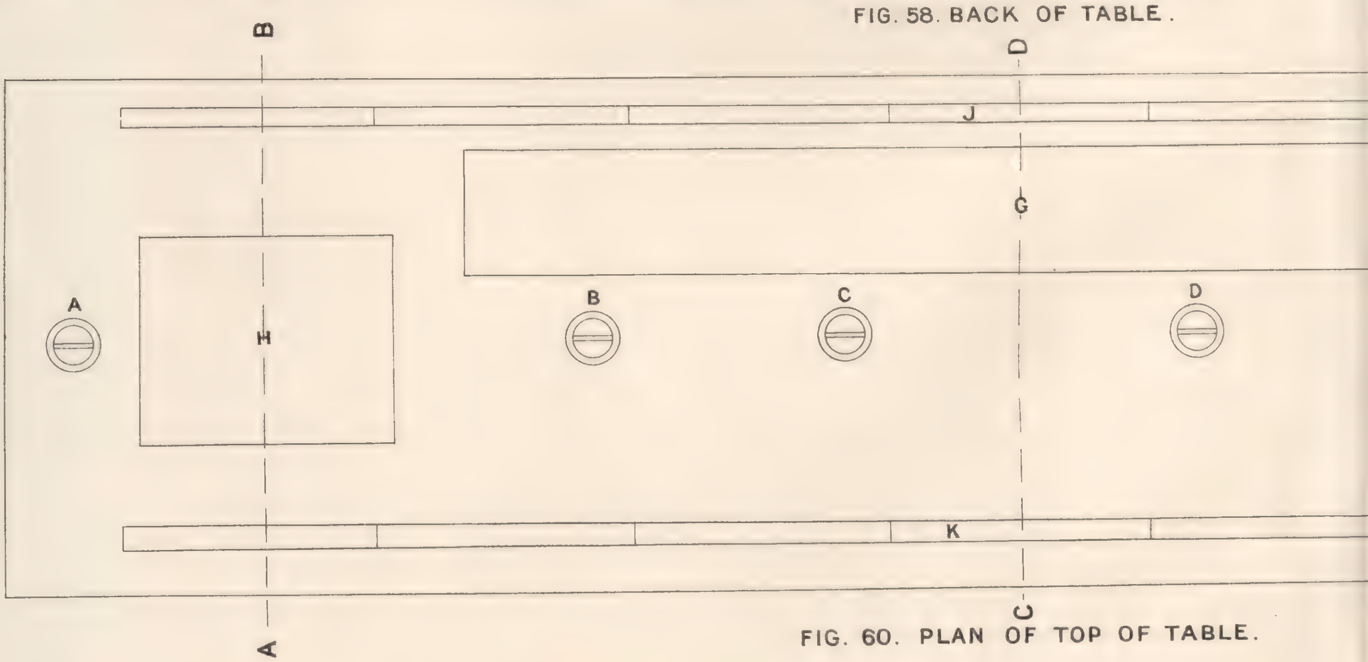
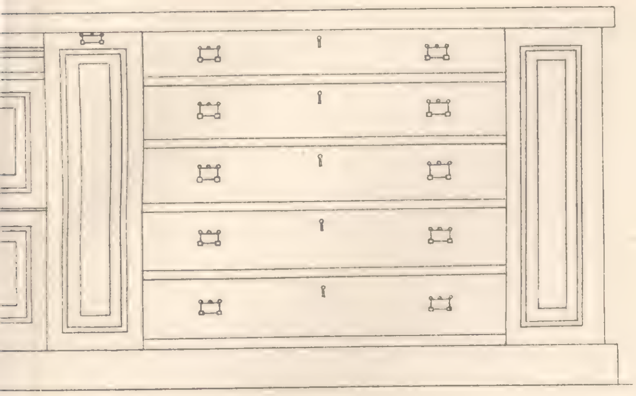


FIG. 60. PLAN OF TOP OF TABLE.

A.B.E.F. *Traps for Gas*
C. *do* „ *Water*
D. *do* „ *Exhaustion*

H.H. *Tank Covers*
J.K. *Electric Wire Covers*
G. *Large Tank Cover*

UNIVERSITY COLLEGE DUNDEE ; NATURAL PHILOSOPHY & MATHEMATICS DEPT
LECTURE ROOM TABLE .



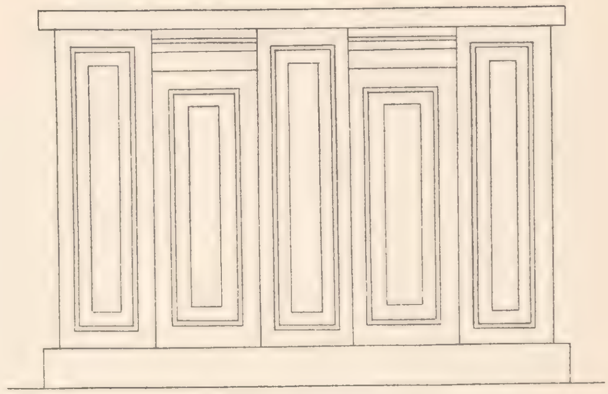
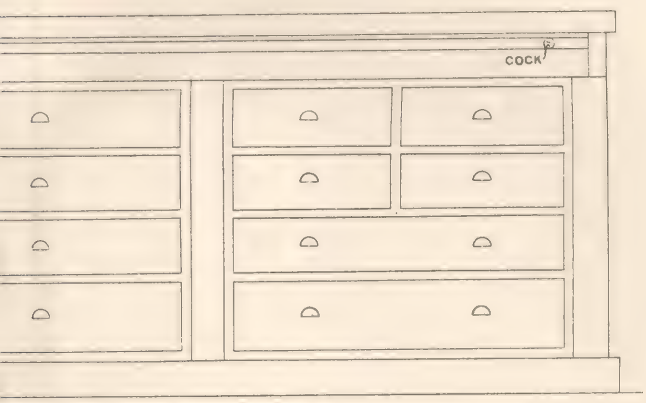


FIG. 57. END



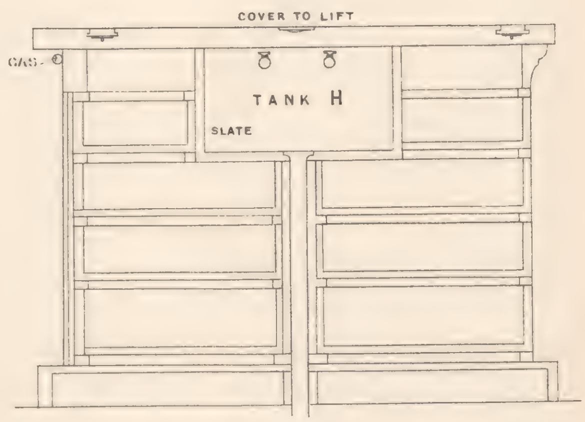
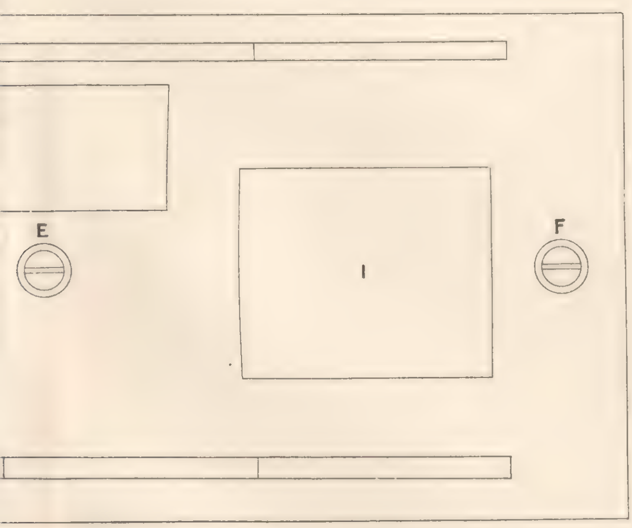


FIG. 59. SECTION AT A.B.



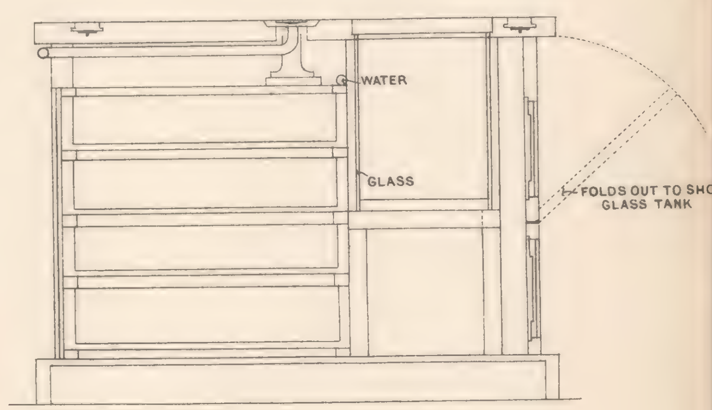


FIG. 61. SECTION AT C.D.

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II. FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS. (xvii)

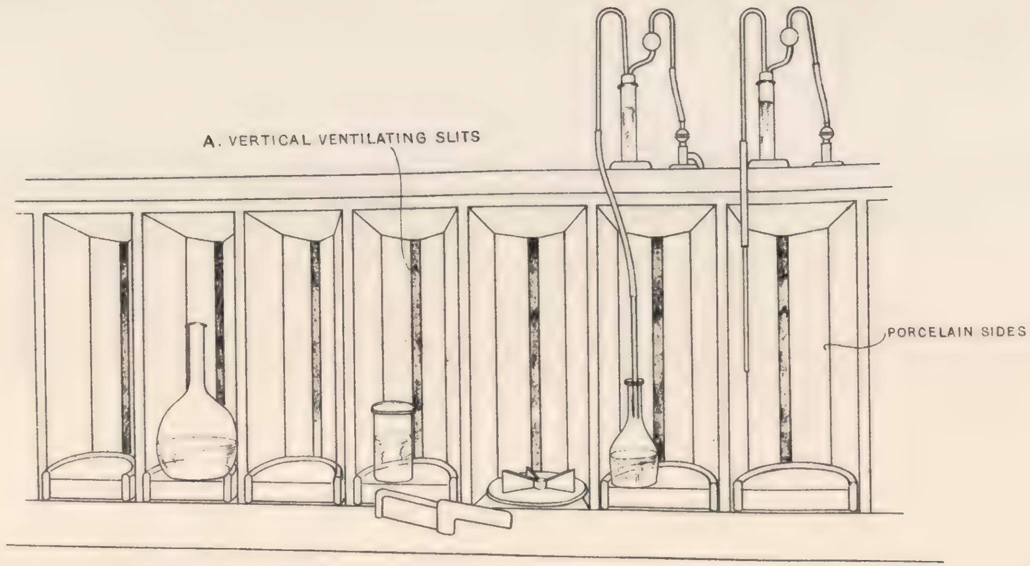
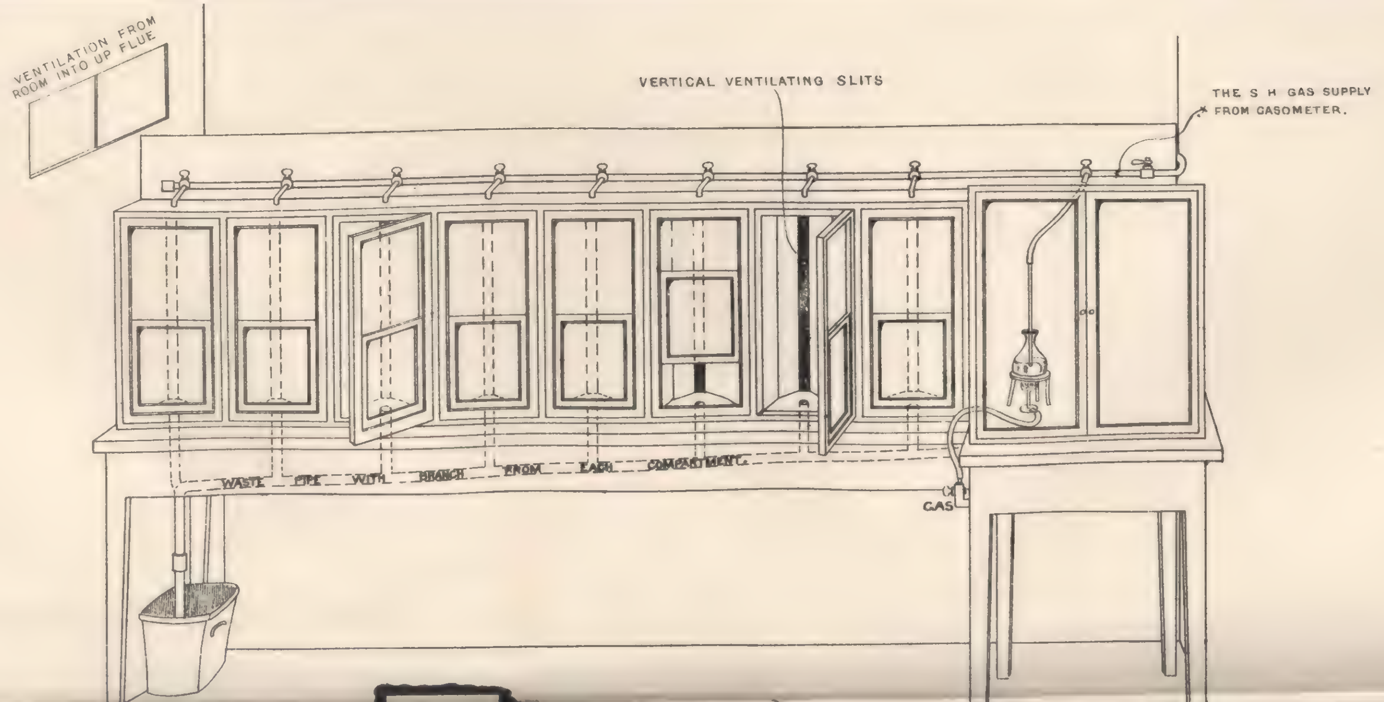


FIG. 82. GRAZ. PEBAL'S SULPHURETTED HYDROGEN CLOSETS, PERSPECTIVE SKETCH.



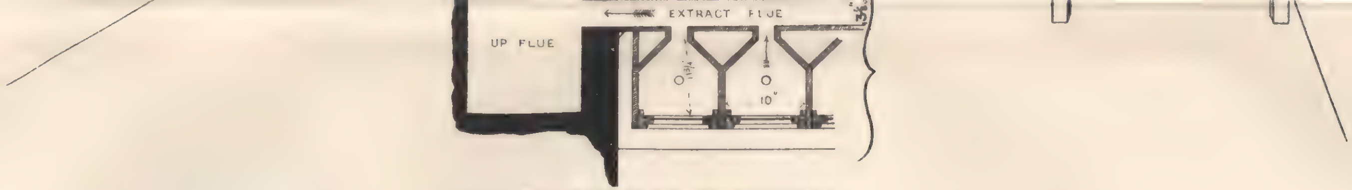


FIG. 63. PART PLAN OF CLOSETS.

FIG. 64. LEIPSIC, KOLBE'S SULPHURETTED HYDROGEN CLOSETS, PERSPECTIVE SKETCH.

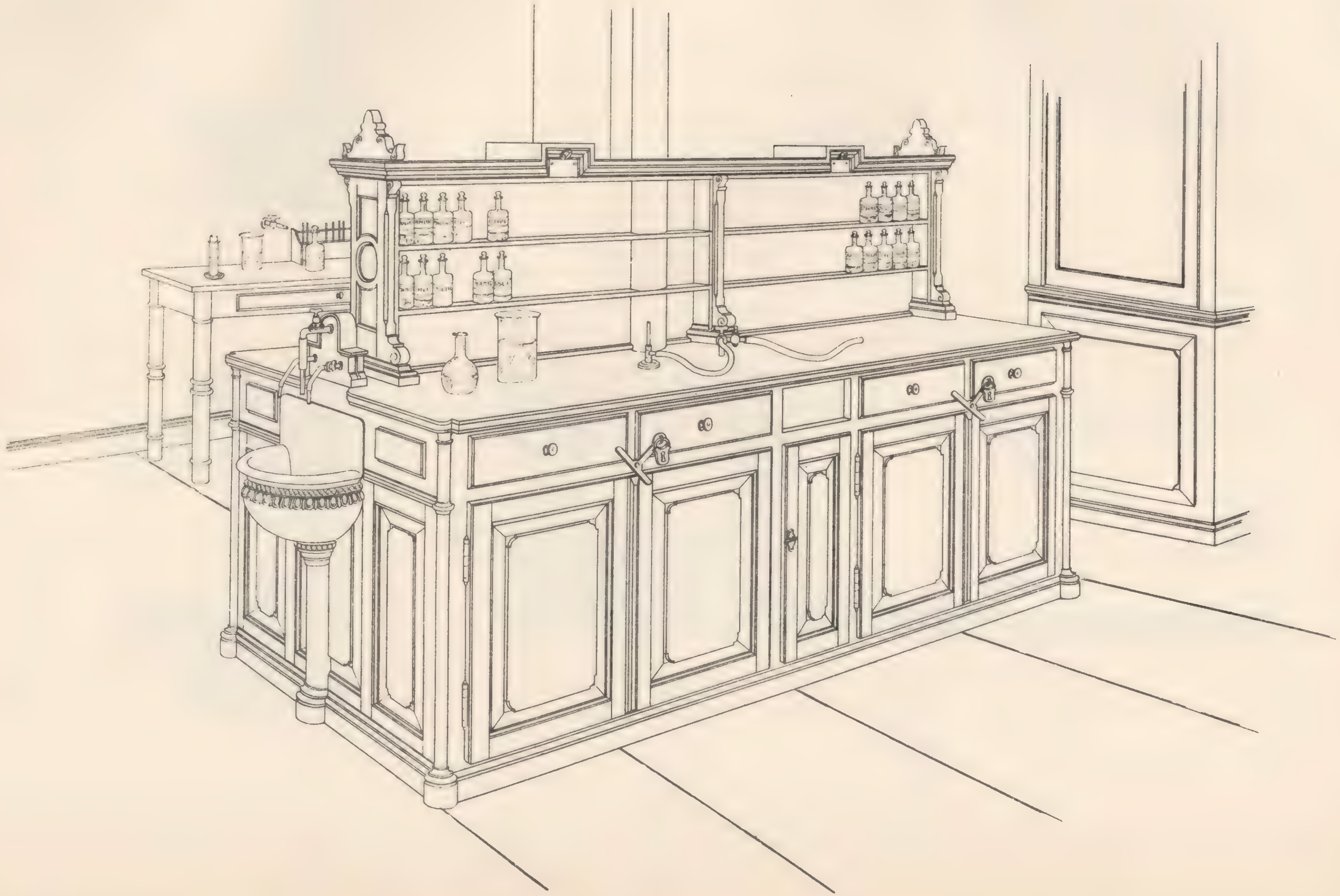


FIG. 65. LEIPSIC, PERSPECTIVE SKETCH OF OPERATING BENCHES.

11, FITTINGS FOR APPLIED SCIENCE INSTRUCTION BUILDINGS. (xviii)

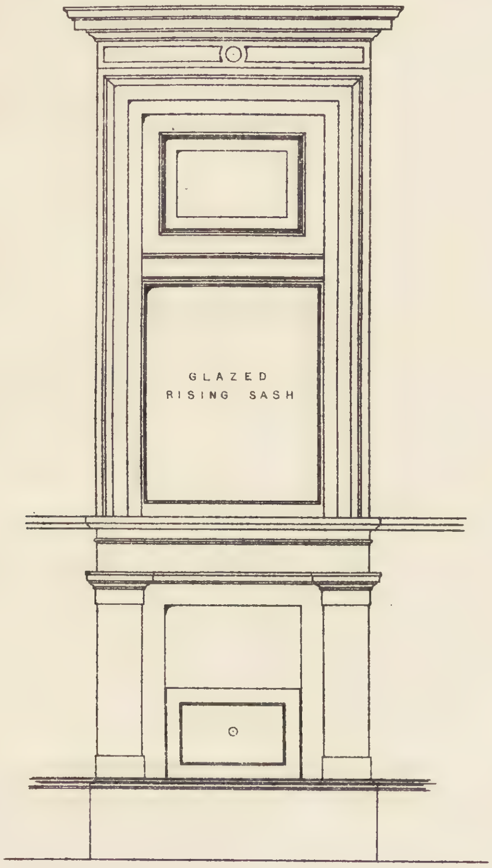


FIG. 66.
ELEVATION.

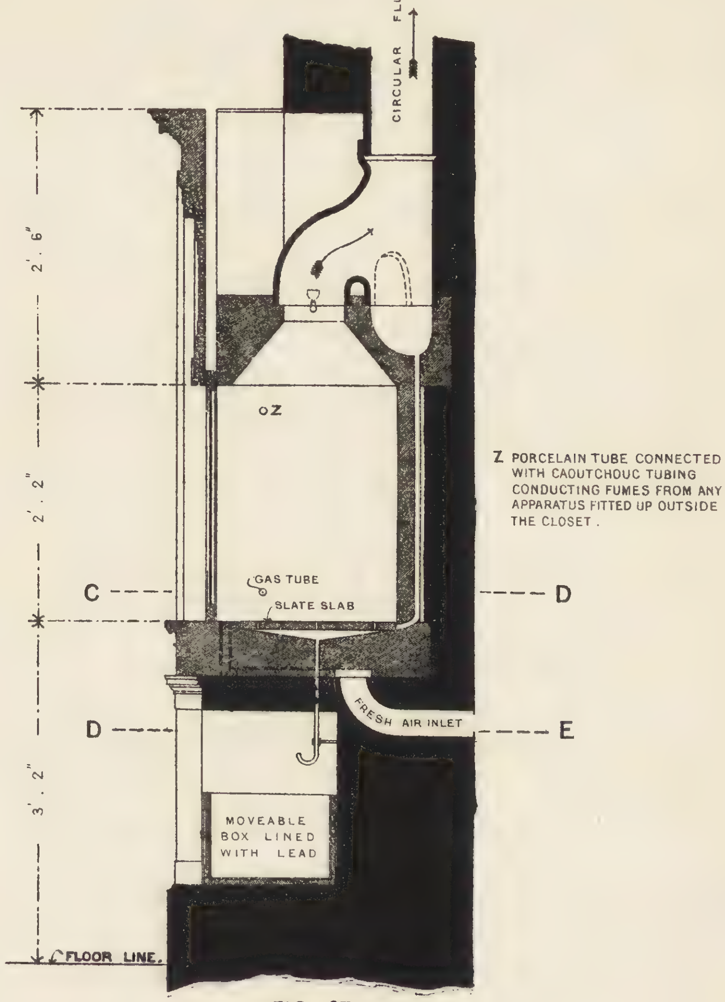


FIG. 67.
SECTION

SCALE.
12 6 0 1 2 3 4 5 FEET

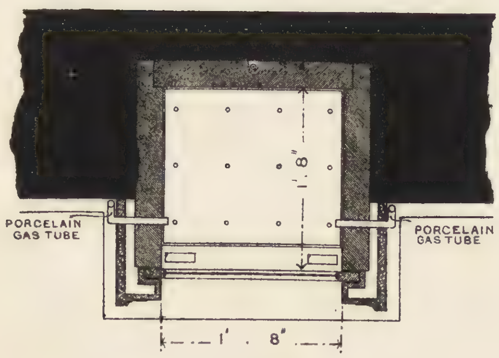


FIG. 68.
PLAN AT LEVEL C.D.

FIG. 69.
PLAN AT D.E.

LABORATORIES AT BONN & BERLIN, DRAUGHT CLOSETS, (HOFMANN.)

C.F. Kell. Photo-Litho. London. E C

III.—HEATING AND VENTILATION NECESSARY FOR APPLIED SCIENCE INSTRUCTION BUILDINGS.

By Edward Cookworthy Robins, F.S.A., *Fellow*.

[Read on Monday, 3rd December 1883, David Brandon, F.S.A., *Vice-President*, in the Chair.]

IN the design of apparatus intended to heat and ventilate buildings destined for the purposes of technical education, a powerful and constant system is essential and should be capable of ventilating both in summer and winter without the assistance of the general heating apparatus; and in consequence of the delicate and sensitive appliances employed in many experiments, the position of the radiating surfaces and their composition must be taken into consideration. In addition to ordinary room ventilation for the removal of the expired air and gas lighting, special means for the removal of noxious fumes generated in the laboratories for experimental chemistry has to be provided. The description of the means adopted in four of the latest applied science buildings may therefore be useful, namely: the Finsbury Technical College, the Central Institution (South Kensington), the Yorkshire College (Leeds), and the Merchant Venturers' School (Bristol). The Finsbury College is exceedingly compact in plan, while at Kensington the frontage of the Central Institution is over three times that of Finsbury College in length, and is of greater depth; but both buildings have a solid internal construction, while the Bristol example, though very compact in plan, presents very little solid wall in its interior arrangement for the passage of ventilating flues and shafts. The Leeds College is straggling in plan and, on account of the varying heights presented by the section of the several parts, presents difficulties for the arrangement of the apparatus quite different to all the others. Three of these examples, viz.: Finsbury, Kensington and Bristol have all been calculated on the same basis of temperature and volume of fresh air for ventilation, viz.: 60° Fahrt. in the class rooms, and 55° in the entrances, staircases and corridors during an external temperature of 25° Fahrt.; with a ventilation equal in volume to 700 cubic feet per person per hour for the class rooms, and 3000 cubic feet per person per hour in the chemical laboratories and draught closets. At Leeds these liberal terms could not be attempted because funds were limited, and therefore only 350 cubic feet per person per hour has been adopted as a basis for the class rooms—the basis for the laboratory being left intact. At Kensington and Leeds the heating apparatus consists of steam radiating chests, while at Finsbury and Bristol the heating surfaces are high pressure hot water tubes, but as each apparatus is distinct in its character, a separate special description is necessary.

Finsbury Technical College.*—Here, as already stated, the apparatus for heating the building is on the high pressure principle, and is constructed for warming by means of "propulsion." The heating power is capable of being directed in its effect, solely or chiefly, to those parts of the building in use for the time being; while at the same time the capacity

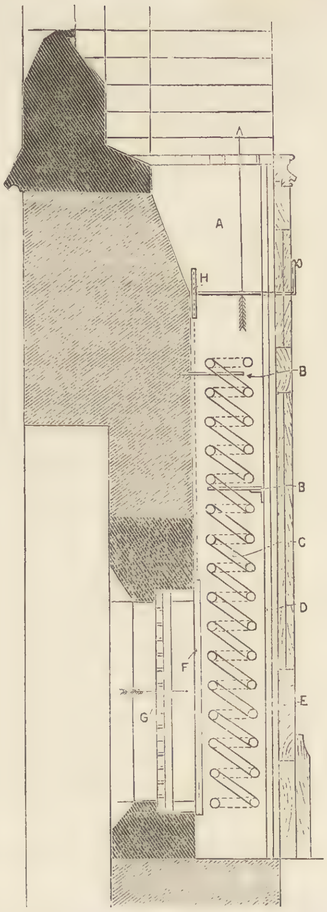
* See, for the plans of this building, Illustns. v-viii.

of the apparatus to, at any moment, suddenly raise the temperature of any portion of the building is notably increased. The heating surfaces (consisting of 13,000 feet run of wrought iron tubing $1\frac{5}{16}$ in diameter), have all been massed in a central hot chamber in the basement [see basement plan], through which fresh air in considerable volume (viz. 750,000 cubic feet per hour), is driven by a screw-fan of Schiele's construction, working silently and making 250 or 500 revolutions per minute. The fresh air thus propelled is heated in this chamber to a temperature of 102° Fahrt. (the heating surfaces or pipes have a mean temperature of 237° Fahrt.), and passes along horizontal channels under the basement floor, from which it is distributed over the building and into the several rooms by means of vertical shafts in the walls, in quantities proportionate to the volume of ventilation it is desired to effect, and to the extent of the cooling surface they severally present. As already mentioned, the apparatus is constructed to yield a general temperature of 60° Fahrt., while the external air is at 25°, and with the normal power of ventilation. Since, however, this difference of temperature is of but rare occurrence (the mean winter temperature for England is 39° Fahrt., or about 14° higher than the accepted base), the heating surfaces have been distributed over two furnaces, of which one or other, or both, may be used as circumstances may dictate. The fan employed is capable of delivering twice the cube of air necessary for winter ventilation, so that in summer the volume delivered into the building can be notably increased. Since in the case of such an apparatus the intake of fresh air is due to mechanical force, the extract has been left to natural means. Flues have been carried up in the walls to the roof of sufficient area to carry off the volumes of air intended for summer ventilation with the velocity arising from the impulse of the fan at the mean summer temperature; and since in the winter the velocity in these flues would be in excess of what was required, the openings into them from the rooms have been provided with closing-gratings, thus providing the means of regulating the egress. The reason for adopting the high-pressure system in preference to any other for the heating is, that by the use of short circuits, and many of them, this apparatus can be constructed to be almost instantaneous in action, attaining its full heat within twenty minutes from the time of lighting the fire, cooling as rapidly also when the fire is extinguished.

Central Institution at South Kensington.*—This apparatus, though very similar to that already described, as far as the bases adopted in calculating for difference of temperature, &c., are concerned, is widely different in system and method of application. The southern wing of the building is only partially constructed, and the system adopted has therefore been chosen with a view to its later extension; and although the limits of the present construction might have permitted of the use of a common hot chamber, its future size altogether excluded the adoption of such a means of warming, and even its present size would have rendered necessary an enormous loss of temperature to the hot air passing along the channels, so that it would no longer have been either desirable or economical to adopt such a system of heating. Messrs. Bacon therefore designed and executed a system of steam heating apparatus with separate hot chambers for each room. These hot chambers are arranged in a row along the basement corridor, and contain the requisite amount of heating surface, consisting of cast-iron ribbed steam chests, jointed together with flanges and bolts with an asbestos ring between by

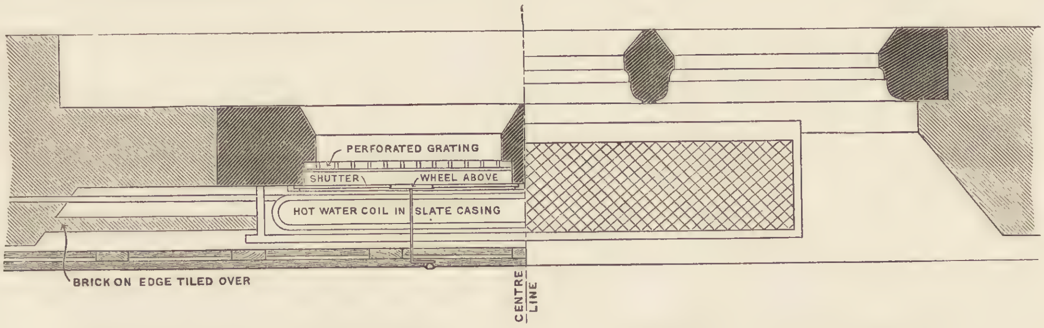
* See, for plans of this building, the Transactions, 1882-83, Illustns. xxxix-xliii, attached to Mr. Robins's Paper on "Buildings for Applied Science and Art Instruction," page 81 of that volume.

way of packing. Each group is fitted with valves for its exclusion from the rest of the system, and is supplied with fresh air from a pressure chamber extending over the whole corridor, into which the air is driven by a large screw-fan as in the former case. Throttle valves are provided to each cold air downcast, so that the supply can be regulated according to the temperature of the room served, which it is proposed to indicate by distance thermometers connecting the rooms with the groups themselves. The section of the warm air upcast shafts is in every case calculated according to the normal temperature of the warm air escaping from the hot chamber, and the volume of such air which is to be delivered into the rooms. The distributing steam mains will be placed overhead in the pressure chamber already described, while the condensed water returns to the reserve tank, placed in channels under the floor. The apparatus is provided with pressure reducing valves, limiting to two atmospheres the pressure of the steam escaping from the boilers to the several groups of heating surfaces, while steam-traps on the condensed water returns prevent the waste of steam. The extraction of foul air is in this case also due to natural means; the various upcast shafts being arranged in groups one over the other, concentrated in a common central shaft ever increasing in size as they rise. The extraction from the laboratories, &c., is specially provided for by a powerful fan, twice the power normally intended, so that a strong summer ventilation may be readily obtained.



SECTION.*

THE MERCHANT VENTURERS' SCHOOL AT BRISTOL.—In this building, the necessity for keeping within limits of expenditure dictated by economy, together with the very light nature of the internal construction, precluded the adoption of an indirect heating apparatus and rendered desirable the direct application of the high pressure system, which is more economical in first cost



HALF-PLAN THROUGH WINDOW-BACK, SHOWING COIL CASING, &C.

HALF-PLAN OF WINDOW-BOARD, SHOWING AIR GRATING.

* A. Warm and cold fresh-air chamber; B. Baffle plates; C. Wrought-iron coils; D. Slate casing; E. Oak panelling; F. Shutter; G. Fresh-air inlet; H. Wheel for opening and closing shutter (Bristol example).—E. C. R.

and subsequent maintenance than any other. The heating surfaces will therefore be distributed along the external walls in the form of coils, which will be placed in the window-backs in slate-lined chambers behind the oak dados [see the two marginal illustrations]. The fresh air being brought in by external gratings through internal regulating valves working in grooves horizontally or vertically as the case may require. On passing into the coil chambers the fresh air is conducted past horizontal baffle plates over the hot-water pipes entering the rooms in a vertical current at the level of the window sills ; well warmed in winter and cool in summer. The connection pipes between the coils will be carried on cast-iron standards projecting 2 inches from the walls over all, and will in all cases be arranged for two flows and two returns, which will be placed behind the skirting, covered with asbestos lining, so as to heat only by the coils which are under control. The hot-water pipes will be charged with a non-freezing solution which will prevent all possibility of accident through frost. The extraction of expired air will be effected by mechanical contrivance, and for this purpose all the extract shafts will be led downwards to a common collecting horizontal channel under the central corridor of the basement floor. This channel is graduated in size towards the screw-fan actuating the current to the ever increasing volume carried, and the increasing velocity due to the extractor. This extract fan will act not only in the ordinary ventilation, but also in the laboratories and draught closets, for which therefore in this case no further special means of extract will need to be provided, except that the flues will be tarred inside. The furnaces for the heating apparatus will be two in number, each furnace working, as far as arangements will permit, about half of the surface in each room, so as to allow of one or the other, or both being employed, as the exigencies of the external temperature may demand. By the use of four-way valves any one or more coils may be disconnected [see Illustn. i.].

The Yorkshire College at Leeds.*—The apparatus for warming will be by steam heating chests placed in the rooms themselves, with fresh air passed over them, similarly arranged to the hot-water coils at Bristol. As at Kensington, each group will be provided with valves for regulating the temperature ; and the pressure of steam in the whole apparatus will be limited, by aid of pressure reducing valves, to two atmospheres.

LABORATORY VENTILATION.

In applied science buildings we have not only to deal with the close atmosphere arising from the congregation of many persons in one room at one time, and for a long time together, but we have also to contend against the obnoxious smells caused by the experiments carried on in the various laboratories. The removal of these fumes with the greatest rapidity and certainty is best accomplished where the current of air in the extracting shafts of the ordinary room ventilation is in the same direction as that of the draught closets on the benches or around the walls. This is so obvious when thus plainly put, that it will hardly be credited that in the majority of cases the reverse is the practical fact, thus necessitating the closing of the extract gratings for the ordinary room ventilation, that they may not pull against the extracts from the operating benches and draught closets.

The velocity at which the extraction of air should take place in the draught closets is not less than 5 feet per second. To ensure this draught at a constant velocity, it is necessary to

* See, for plans of this building, the Transactions, 1882-83, Illustns. xliv, xlv.

be independent of casual winds and changing temperature as a means of motion. This requires the employment of certain apparatus to produce either a propelling or a sucking force, of which the latter is usually either a common upcast shaft, heated at its base by a furnace, or the product of furnaces, attached to engines or heating apparatus. Neither of these, however, can be depended on for constancy, and therefore the best agency is a fan; the rotation of which, propelled by a steam, gas, or electric engine, where water power is not available, steadily exhausts the air from the air-channels and establishes an upward and outward current in the shaft from the point at which it debouches. The position in which this extract fan is placed in the shaft, determines whether the vertical warm air-channels shall have an ascending or descending current established within them before reaching the shaft. If placed below the basement and at the foot of the shaft, the current will be descending—if placed at the roof level the current will be ascending—to communicate in each case with horizontal channels, graduated in size, till they reach the spot where the fan is situated.

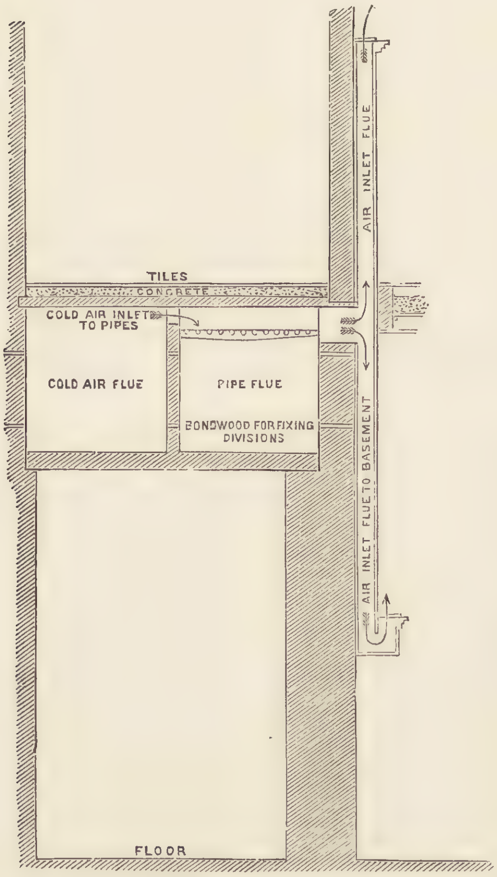
In many cases on the Continent there are fans both above and below, as at Geneva; in others above for the draught closets only, and a furnace below for the room ventilation. This is the case at Munich, for example, with the result I have already mentioned, but I should explain, that fresh air is separately admitted to the draught closets as well as the room, and it was thought that this would overcome the difficulty, but it does not in practice, and we should take warning. Of course it is apparent that the extraction of so much bad air must be replaced by a corresponding amount of fresh air, warmed on its entrance in winter, and cold in summer, the only way I know of to prevent cross draughts is to introduce this fresh air with an upward current through vertical shafts, or openings not fixed in the face of the side walls; then whether you force the air in by fans or leave it to come in as it is drawn, its tendency is to rise before mingling with the air of the room. I am so arranging it at Bristol, and it is so introduced at Dundee. In summer the room openings for the escape of the foul air may be at the top of the opposite wall, but in winter, if they are not also provided at the bottom of the room, so that the upper can be closed, the warm air will be carried away before warming the room; in either case the air will be pure, because it will never have time to get stagnant, but will always be changing as many times in the hour as may be predetermined.

Between the operating benches and draught closets, and the extracting shafts, there are horizontal foul air channels of communication over or under the floors. [Illustns. i, ii and viii, *ante*]. At Finsbury the channels were arranged very carefully by Dr. Armstrong, and the sizes were calculated by Messrs. Bacon & Co., and the plan which illustrates them gives also the exact graduated width, the depth being the same throughout, set in a layer of concrete 8 inches thick over the fire-proof floor of the laboratory, lined with Portland cement and pitched inside and covered with plate glass puttied in, over which are the iron cover plates which are flush with the floor. At Finsbury the wastes from the sinks are carried into similar channels to the out-fall pipe; and as at Munich and Strassburg there are other channels for gas and water piping, these channels of course have no glass covers like the foul air extract flue channels; the foreign examples are lined with asphalte. There are other horizontal channels at Finsbury which are above the level of the floor, and are formed of dove-tailed wood pitched inside. At the Merchant Venturers' School, Bristol, the air-channels are of wood pitched inside, and with slight variations will be all arranged under the floors, in the manner

shown in the drawings of the topmost floor of that building, showing the arrangement of the rooms, the fittings, flues and waste water pipes.

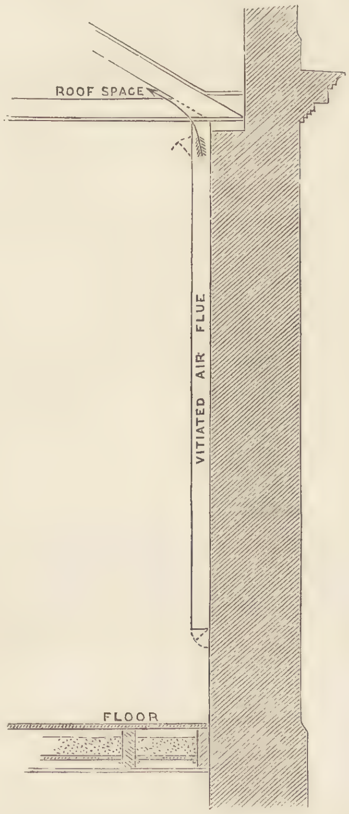
In the Finsbury College, the general ventilation of the chemical laboratories is effected by the bench draught flues, to prevent any counter-action by subsidiary extract shafts. These bench flues will have their openings about five feet from the floor, and be covered with sheet-iron and glass hoods. Their exact form, and the detail of their appurtenances, have been decided by Professor Armstrong after a series of exhaustive practical experiments; each flue is in direct communication with horizontal channels running underneath the floor, radiating towards the ventilating shaft. In the case of the four schools described, the area of the flues and channels have been carefully calculated by the aid of Professor Wolperts' elaborate formulæ, at every juncture, with reference to the probable velocity to be attained, and the quantity of air to be carried per second. As an example of the sort of calculations involved, the table prepared for the school at Bristol is hereto appended. The cost of the apparatus exclusive of the bench and floor and wall flues, the mason and carpenters' work and painting amounts to £4,000 for Kensington, and about £2,000 each for the other three buildings.

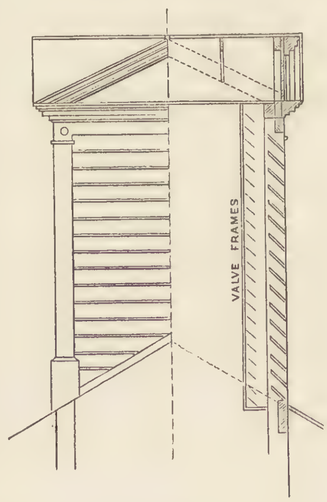
The application of this principle of forcing in air, and leaving it to find its way of escape by any outlets designed or undesigned that may exist, has been applied to the new Chemical Laboratory at Dundee. There the mode of ventilation is known as Cunningham's, and the heating by Perkins's system of wrought-iron piping at high pressure. The machine chamber, situated in the basement floor, is a large room, and contains five of Cunningham's air pumps driven by a two-horse-power Otto gas engine. The fresh air is taken in by two inlet shafts at the back of the building, carried up almost to the height of the eaves, the upper portions of which are louvre-boarded. The pipe and air flues are placed as far as possible under the ground-floor corridor, and are 3 feet square, but those under the laboratory and lecture theatre are 3 feet deep and 4 feet 9 inches wide, and all the air flues have openings into the machine-room. There are twelve pipes abreast in the 3 feet and twenty-four pipes in the 4 feet 9 inches flues. The pipes are placed at 6 inches from the top of flues, and are supported on notched cast-iron brackets. There are two furnaces employed in heating; the pipes from No. 1 are taken in one direction through the flues, and the pipes from No. 2 in another, made to have the flues equally heated. When the weather is mild one furnace may only be used. The flues are formed of brick with concrete bottom, and covered with pavement flags



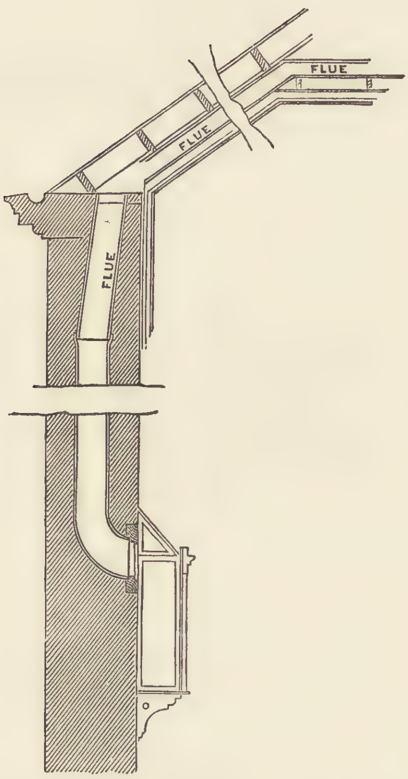
jointed with cement. The air flues are in all cases run alongside of the pipe flues, and openings are left in these at stated places for the air to pass over the pipes. The pipe flues have also close divisions to regulate the number of feet of piping according to the size of the room to be heated. The heated air from the pipe flues is admitted by upright inlet flues placed on the walls of the rooms, and these discharge the air 5 feet from the floor in an upward direction. These flues are made very flat in order to diffuse the air well and prevent draughts. The inside of the whole of these upright flues, and all the close divisions and other wood-work in the pipe flues have been thoroughly painted with asbestos paint. Wire netting, half-inch mesh, has been placed over the mouths of all the inlet flues.* The *extract* flues are placed generally on the opposite side of the room from the inlet flues; they are also constructed of wood, and are placed on the walls and are of equal area to the inlet flues in the rooms. These flues come to within 2 feet of the floor, and have a valve on the bottom which can be closed when required; they have also valves near the ceiling which will only be used in summer. The air from these flues is led into larger flues formed in the roof space, which are connected to louvre--boarded ventilators placed on the ridge of roofs. These ventilators have value frames placed about 6 inches from the inside of the louvre boards, and are formed into squares of about 4 inches. Each square has a valve or flap of indiarubber cloth, which shuts when the wind blows and the opposite side from the wind opens. The area of the openings in each side of these roof ventilators is equal to the area of the whole of the exhaust flues

SECTION OF AIR INLET FLUE IN ROOMS





* Sir Frederick Bramwell remarked that architects as a rule thought more of extracting the foul air than of supplying fresh air, and were satisfied with making holes in the roof for its exit and none for its entry; whereas he would reverse that operation, and provide for the inlet of fresh air, leaving to its own sweet will the manner of its escape. In all the examples referred-to in the present Paper the architects have considered the introduction of fresh air as, at least, of equal importance to the extraction of the foul air. I may also refer to the system successfully applied by me to the meeting-room of the Society of Arts, with the approval of Sir Frederick, which earned for me the formal thanks of the Council when the late Sir William Siemens was Chairman. Here the fresh air enters by five inlets, and, passing over warmed piping, is admitted through an iron grating 6 inches deep, extending the whole length of the north, and part of the east side of the hall, at about 10 feet from the floor. Moveable horsehair screens are placed at the inlets, to filter out the impurities in the air which might otherwise damage James Barry's pictures. A coil of hot-water pipes, situated in a shaft above the level of the ceiling, extracts the foul air through the openings in the ceiling by means of zinc connecting channels, assisted by the central sun-burner.—E. C. R.



connected with it, so that when two sides are closed by the wind the other two allow the vitiated air to escape. The whole of the evaporation niches, stink hoods and closets of students' tables in the building are connected to the large air flues in the roof space by fire-clay pipes built into the walls, and by lead flues from the wall heads to the flues in the roof. The draught from these different places is found to be excellent. The quantity of air forced into each room is calculated to renew the whole air in the room at least every twenty minutes. There is a horizontal flue under the floor of the laboratory to which the whole of the descending flues from the students' working tables are connected. There is no fan connected with the discharge of the air. The air is forced into the rooms, and being always under pressure finds its way out at the openings provided for it; in no case does the area of the exhaust openings exceed the area of the inlet flues. In the students' laboratory the valves of the exhaust ventilators can be closed, which has the effect of increasing the current in the draught closets, &c. It is obvious however that the removal of this pressure of the incoming air by the opening of windows will be inconvenient in summer time, but this might be overcome by introducing air under pressure into the extract flues of the draught closets.*

EDWD. C. ROBINS.

* Institution of Civil Engineers.—An interesting discussion took place at the Institution of Civil Engineers last November, on the reading of a Paper by the late Robert Briggs, on "American practice in warming buildings by steam," to which I must refer the reader. The following description of the mode by which the Meeting-Room of the Institution of Civil Engineers is warmed and ventilated will be interesting, as giving an example applicable not only to the large lecture halls of science schools, but even to laboratories, the particulars of which have been supplied to me by Mr. Phipson, of Salisbury Street, Strand, by whom the work was designed and executed. It should be noted that, had not the architect, Mr. Thomas Henry Wyatt, sacrificed some of the space in the lower rooms, the result mentioned by Sir Frederick Bramwell would not have been obtained. Mr. Phipson's experience has convinced him that failures in ventilating arrangements can in many cases be traced to the want of sufficient area in the inlet shafts. The fan which propels the air is worked by a Ramsbottom patent water engine, driven direct off the high pressure water main. The air shafts leading from the fan are so arranged that, by working a valve, the air propelled and forced into the building can be either passed through the heating chamber containing coils of hot-water pipes, or direct up the air shafts to the meeting-room. On a level with the meeting-room floor a secondary or distributing chamber is formed by utilizing the space under the raised platform of the rising seats, and the air from the fan being distributed on the three sides of it. The perforations from this chamber are calculated to supply a volume of air to the meeting-room equal to six times its cubic contents in the hour, diffused at a velocity not exceeding six inches per second. No special means for carrying away the vitiated air are provided except the usual outer shafts around the sun-burners that light the room, the area of these outlets being much less than that of the inlets. By this you will perceive that the principle adopted is to ensure a supply of fresh air equally diffused, that any stagnation of vitiated air is improbable, for though the outlets around the sun-burners are not equal in area to the inlets, the pressure maintained ensures an outlet at other points, and thus prevents any local inlet currents of air from the exterior of the meeting-room.—E. C. R.

[Remarks by Mr. W. W. Phipson, Ventilating Engineer.]

The principle at the Bute Hall, Glasgow, is somewhat similar to that employed at the Institution of Civil Engineers. The object of this apparatus is to ensure in Halls and Assembly Rooms an outward current. We all know as a fact, that an inward current into a Hall or Assembly Room follows the opening of a door; in comes the air and there is a draught, but by increasing the inward pressure by means of a fan, and having few outlets less in area than the inlets, the air then finds its way out through the nearest openings. The last time I was at the Bute Hall, Glasgow, although there was a very strong wind blowing against the windows on the one side, I put the fan to work; Sir William Thomson happened to be present at the time, and we very much doubted whether it would be possible to overcome the inlet draught caused by the high wind, which was then very strong, for the University is built on a high site in Glasgow, but imperceptibly the air was blown out through the windows by the action of the fan, and this was very satisfactory. In order to overcome any prejudice that might exist as to the outlet of the air, there are four turret stair-cases, and in them a provision is made at the level of the floor for allowing the air to escape, so as to prevent any stagnation in the room. There must be an outlet of some sort, and after all the doors and windows were closed, then the outlet would naturally be through the openings near the floor at the staircase. Again, I have had a rather difficult problem set me at the new Medical School at Edinburgh. There we are to have a good many draught closets in the chemical department, and although I find at present a little difficulty in getting horizontal draughts in what are called the experimental tables fixed in the centre of the Laboratories, yet with the side draughts I have no difficulty, and I find that in one simple draught for the side closets, going direct down the wall and communicating immediately with the underground flues to the main shaft, I got as much as 8, 9, and 13 feet per second velocity, and I am convinced that if the draught is less than 6 to 8 feet in these horizontal draught-chambers, the chemical fumes will not be removed sufficiently for the requirements of the professors. I have tried the horizontal experiment tables in the same vertical shafts: the velocity was reduced to 4 or 4·8, as nearly as my memory can carry me. The chemical fumes produced by the professor, for the purposes of this experiment, were far more powerful than those which will usually have to be dealt with, and nearly the whole of the fumes were removed with the velocity just mentioned, but certainly no velocity under 5 or 6 feet per second will remove them entirely.

W. W. PHIPSON.

[Remarks by Professor Perry.]

With regard to ventilation, I may remark that the velocity at which the air is passing through an orifice in a certain neighbourhood gives us really very little information as to the amount of draught in that neighbourhood. Of course, we know that, if the orifice is small, we shall have much greater velocity, so that we ought to have a little more information as to the size of the orifices before considering whether a certain velocity of air is sufficient for removing chemical fumes. I think that Dr. Armstong found that 4 or 4½ feet per second was quite sufficient velocity at the orifices to produce a very perceptible clearance of the fumes. When on this subject, I may say that Professor Ayrton, three years ago, brought before the Institute

some of the calculations that he and I had made with regard to draught, and he then asserted,* after giving the mathematical formula, that ventilation by the rise of heated air cannot be $\frac{1}{30}$ as efficient as ventilation by fans, even taking into account the want of efficiency in steam engines which might drive the fans. In our opinion, the ventilation of the future would, we believed, be performed by electric machines driving fans. I hope that the experiments Dr. Armstrong is making, which, I believe, are almost the first made in an actual building for the purpose of obtaining specific results with an electro-motor driving a fan, will lead architects to turn their attention to the actual method of experimenting at Finsbury. When they see the small size of the electro-motor that is required to give out two horse-power, the weight being only about 100 pounds; that it can be placed in any position; that it can give off the power at any distance from the steam engine or water wheel; and when they find that only two dangling wires need come up the outside of the house, entering the room by an opening in the window, if necessary, they will give greater attention to the suggestion of Professor Ayrton than perhaps they have done heretofore.

JOHN PERRY.

[Remarks by John Slater, B.A., *Fellow.*]

The system of exhaust closets is one of very great importance, and merely another branch of the wider question of proper ventilation of large halls and buildings containing a number of rooms. This is a subject much too complicated to discuss in a few remarks, and I only allude to it for one reason. If you have to exhaust a comparatively small quantity of air, and if the rate at which that air is exhausted is not very rapid, heat is a sufficiently powerful agent. You can have an exhaust shaft, and by burning gas-jets in it the air will be rarified and a continuous current will be set up, but if you have a much greater quantity of air to exhaust, and at a much more rapid rate, this will not be sufficient, and you must employ some mechanical means. Fans have been mentioned once or twice to-night, and hitherto they have been the only method, as far as I am aware, by which this has been accomplished, but there are certain great drawbacks to the fan, as I have had occasion to experience. The vanes of a fan are generally the weakest part of the whole structure, and the consequence is a great tendency on the part of these vanes to become slightly worn at the extremities. This will not be so much the case when ordinary air is dealt with; but cases occur in which fans have to be used for exhausting gases that have a very deleterious effect upon the metals and other materials of which the fans may be made. If the edges of the vanes of the fans get slightly worn away considerable difference is made in their efficiency. A few weeks ago I visited some large ironworks in the Midland counties to inspect some castings, and I found in operation at one of them an apparatus which struck me as the most perfect specimen of exhauster or propeller that I have ever seen. It is called the Baker patent Rotary-Pressure-Blower, and is, I believe, an American invention. It was used for the purpose of forcing air into a blast furnace, but it is quite different in action from a fan. It is impossible to describe a machine of this kind without diagrams, but it consisted of a series of three discs, which revolved one upon another within an iron casing, and its effect was very

* See the TRANSACTIONS, 1880-81, for Professor Ayrton's remarks and calculations, pp. 97-100.

powerful. I was told that these machines are made of varying capacities, and are capable of extracting from 600 to 2000 cubic feet of air per minute. The enormous advantage is this, that if the gas you have to exhaust is deleterious, it need not pass through the machine itself, but can be drawn away on one side and propelled through another aperture. If any one had to design any scheme for exhausting air or ventilating a building I should strongly advise him to see the machine to which I refer.

JOHN SLATER.

[Notes by Professor Armstrong, Ph.D., F.R.S.]

Our experience has shown that the system adopted here* of warming and ventilating the building is on the whole satisfactory, but several defects have been discovered which are partly inherent in the system and partly faults of construction. The chief merit of the system of propelling fresh air through a heating chamber by a powerful fan is its simplicity, and, provided that the flues are so proportioned as to deliver the exact amount of air required to maintain the various rooms at the proper temperature, there should be no difficulty on this score. Although calculated with the aid of Professor Wolpert's elaborate formulæ, we find in practice, by careful test experiments, that the various flues do not all deliver air at just the rate and of just the temperature which is required for the efficient warming of all the rooms, and in some we are over-heated and in others underheated. Whether this is due to a misapplication of the formulæ or to the omission of sufficient allowance for distance, or to the irregularity in the direction or formation of the flues, further experiments will probably reveal. The most serious objection to our Finsbury system arises from the fact that ventilation and warming are inseparable; in other words, if the temperature in any room be sufficiently high, and it is required to introduce more air, this cannot be done by the apparatus without also raising the temperature. It ought to be possible to admit warm and cold air in varying proportions or, which is the same thing, to increase or diminish the supply of air, and at the same time diminish or increase its temperature, so as to ventilate more sufficiently while maintaining the temperature constant.

Another difficulty arises from the large amount of dust injected into the rooms with the air. This partly arises from the fact that the flues have been "parged"—a grave sanitary mistake; but it is partly unavoidable. The interposition of a screen, sufficiently close to prevent dust being sucked in by the fan, interposes too great a resistance; we are intending to try the effect of a very fine water spray. Probably there would be much less dust had the air been taken in at a higher level—near the roof.

Graduating the flues in the manner shown by the plan of the laboratory floor (viii) has not been altogether satisfactory, and theory evidently does not quite accord with practice; the pull, in fact, instead of being equal throughout gets less and less as the distance from the extract shaft increases, and will need to be experimentally adjusted.

It was originally proposed to produce the draught in the flues leading from the benches in the chemical laboratory by connecting them with a downcast shaft which, at the basement, joins the main upcast shaft, 120 feet high, within which is a circular iron smoke shaft,

* At the Finsbury Technical College. See Illustns. v-viii.

18 inches in diameter. The waste heat from the heating furnaces and the steam boiler was to produce the necessary draught. This, however, has not been successfully accomplished, and a number of experiments which we have made seem conclusively to establish the inefficiency of the arrangement: we find that whether we allow merely the waste heat from Messrs. Bacon's furnaces, or also that from our large steam boiler furnace, or even the heat from these two sources, *plus* that from a furnace 18 inches square at the very base of the shaft, to escape into the central cast-iron smoke flue, there is practically but little difference in the velocity of the current in the downcast. The explanation would appear to be that the velocity of the current in the iron smoke shaft is so great that the smoke does not part with its heat with sufficient rapidity to the air in the lower part of the upcast shaft external to it at the point whereat the downcast is connected. This has led to the interception of the laboratory ventilation, and the results, which we have obtained with a 2-feet Blackmann fan in connection with the laboratory flues, leave no doubt, in my mind, of the ultimate success of my hood arrangement; and, in the future, mechanical ventilation will, I believe, unquestionably be the right thing for a chemical laboratory. All we require now to do is to experimentally study the conditions requisite under our system to obtain an even flow in all the flues.

HENRY E. ARMSTRONG.

Table of Calculations for Heating and Ventilating the New Bristol Trade & Mining School.

No.	Name.	Cubic content in feet.	Fresh air required per hour for ventilation, in cubic feet.	Ditto, ditto, in lbs.	How calculated.	Heat lost per hour by deperdition, in units.	Heat necessary to raise fresh air to temperature, t, per hour, in units.	Heat given off by tubes per hour, in units.	Internal temperature, = t, with extl. air at + 25° Fahrt.	Length of tube proposed, $1\frac{5}{16}$ in. extl.
A	B	C	D	E	F	G	H	I	K	L
1	Dining Hall	18544	140000	10682	200 pers. at 700 c. ft. ea.	22206	88981	111187	60°	1112
2*a*10	Cloak Rooms	9384	—	—	—	16875	—	28125	60°	281
10*a*	Lobby	9035	—	—	—	5159	—	8595	55°	86
10*b*	Slope	2173	—	—	—	2980	—	4966	55°	50
10*c*	Stairs	12528	—	—	—	17251	—	28751	55°	287
10*d*	Ditto	20132	—	—	—	20319	—	33865	55°	339
11	Museum and Library	24300	24300	1882	1ce. cubic cont.	30172	15443	45615	60°	456
12	Master's Com. Room	4830	9660	730	2ce. ditto	9072	6949	16021	65°	160
13	Waiting Room	2730	—	—	—	5187	—	8645	65°	86
14	Committee Room	8250	16500	1247	2ce. cubic cont.	12318	11871	24189	65°	242
15	Class Room	8250	35000	2646	50 pers. at 700 c. ft.	10182	25190	35372	65°	354
16	Ditto	8250	35000	2646	50 persons at ditto	7777	25190	32967	65°	330
17	Ditto	8250	35000	2646	50 persons at ditto	7714	25190	32904	65°	329
18	Ditto	8250	35000	2646	50 persons at ditto	8869	25190	34059	65°	340
19	Examination Hall	106800	350000	26705	500 pers. at 700 c. ft.	43592	222452	266044	60°	2660
20	Retiring Room	2430	—	—	—	4317	—	7195	55°	72
20*a*	Corridor	1875	—	—	—	11036	—	18393	55°	184
20*b*	Ditto	6641	—	—	—	3273	—	5455	55°	54
20*c*	Ditto	2250	—	—	—	4875	—	8095	55°	81
21	Engineer's Lect. Room	11925	42000	3204	60 pers. at 700 c. ft.	13282	26689	39971	60°	400
22	Engineer's Diagram „	4770	—	—	—	3644	—	6073	60°	61
23	Artificer's Drawing „	15619	21000	1587	30 pers. at 700 c. ft.	28293	15108	43401	65°	434
24	Class Room	8250	35000	2646	50 persons at ditto	10171	25190	35361	65°	354
25	Ditto	8250	35000	2646	50 persons at ditto	6400	25190	31590	65°	316
26	Ditto	8250	35000	2646	50 persons at ditto	6400	25190	31590	65°	316
27	Ditto	8250	35000	2646	50 persons at ditto	5675	25190	30865	65°	309
27*a*	Corridor	5040	—	—	—	3150	—	5250	55°	53
27*b*	Ditto	3240	—	—	—	7930	—	13221	55°	132
28	Chemical Lecture Room	18802	84000	6409	120 pers. at 700 c. ft.	46983	53386	100369	60°	1004
29	Preparation Room	5670	22680	1715	4 times cubic cont.	12721	16326	29037	65°	290
30	Class Room	2906	10500	794	15 pers. at 700 c. ft.	7163	7559	14722	65°	147
31	Master's Room	5940	11880	898	2ce. cubic contents	13722	8549	22271	65°	223
32	Operation Room	10560	21120	1597	Ditto	14993	15103	30096	65°	301
34	Chemical Laboratory	21600	120000	9072	40 by 50 by 60	24912	86365	111277	65°	1113
35	Phys. Sci. Lect. Room	26048	84000	6409	120 pers. at 700 c. ft.	28620	53387	82007	60°	820
36	Phys. Sci. Laboratory	9280	37120	2806	4 times cubic cont.	12070	26713	38783	65°	388
37	Metall. Laboratory	14208	28416	2148	2ce. cubic cont.	15752	20449	36201	65°	362
38	Special Work Room	2992	11968	904	4 times ditto	3397	8608	12005	65°	120
39	Room	6045	12090	914	2 cc. ditto	10661	8701	19362	65°	194
40	Corridor	2904	—	—	—	2126	—	3560	55°	36
41	Ditto	3592	—	—	—	1164	—	1940	55°	19
42	Ditto	4950	—	—	—	4350	—	7250	55°	72
43	Ditto	1575	—	—	—	546	—	943	55°	9

IV. ENGLISH MONUMENTS OF THE SIXTEENTH AND SEVENTEENTH CENTURIES. By Edward J. Tarver, *Associate.*

[Read on Monday, 17th December 1883, Horace Jones, *President,* in the Chair.]

THE subject of this Paper is one to which I have been led in delivering the course of Lectures on the History of Architecture, which I am now giving for the third Session before the Students of the Architectural Association, with the object of helping them to prepare themselves for the Examination for admission to this Institute. When I come to the lecture on English Renaissance, there is always a difficulty in pointing out a successive architectural development of the features of this style, if style that may be called which combines the elements of two such antagonistic principles as are implied by Classic and Gothic design. Indeed "fashion" rather than "style" is the term to be applied to the architecture of this period, for it was indulged-in chiefly by those who were rich enough to employ special designers, generally foreigners. The national Gothic style survived, at the same time, in many of our buildings, especially in out-of-the-way places, as will be seen in the review of them at the end of this Paper. The case was different with sepulchral monuments, which were, with few exceptions, executed in the Renaissance or fashionable style; while those erected in Westminster Abbey, the very centre of monumental fashion, would indicate the "height" of it, as each was added to that interesting collection.

Some latitude has to be allowed for the interval that elapsed between the death of the individual and the erection of the monument, but assuming that the monuments followed, on an average, within a few years of the deaths, we have a fairly consecutive series of illustrations* to judge from. The first three monuments, namely, Abbot Fascet, 1500, Sir H. Stanley, 1505, and Lord Daubeney, 1507, exhibit no foreign, or, as we must call it, Renaissance influence; but when we come to the next two, namely, Henry VII and his mother Margaret, Countess of Richmond, a complete change is observable.

Before describing these monuments, however, it is necessary to turn aside and visit the monument to Dr. John Young in the Rolls Chapel. This monument, given in the Transactions † as an illustration to Sir Digby Wyatt's Paper, is considered by him to be the first of several on which the Italian sculptor, Pietro Torrigiano, was employed. There is certainly no doubt about the Renaissance character of this monument, which has not a vestige of Gothic feeling about it. The recumbent figure is beautifully modelled, the hands lying clasped. The idea is, that Torrigiano was employed by Henry VIII to try his hand upon this before being entrusted with the more important monument to his Royal Father, and the other to his mother, the Countess of Richmond.

* The illustrations alluded-to were hung on screens during the lecture, and consisted chiefly of tracings from engravings, &c. I have, however, appended to the present publication some rough notes of my own, from the monuments in Westminster Abbey, in explanation of the various distinctive features to which I have called attention.—E. J. T.

† See volume for 1867-68, page 258.

The inscription on Dr. Young's monument says, "Sui fideles executores hoc posuerunt, "MDXVI," which is a satisfactory date to hold on by.

Mr. Wyatt Papworth, from whose recently published little and most useful book, on *The Renaissance and Italian Styles of Architecture in Great Britain during the period of* 1450-1700, I have supplemented my notes, gives 1516 as the date of Henry VIIth's monument, and 1519 as that of the Countess of Richmond's, though both are recorded to have died in 1509, he in April and she in July. Both monuments are ornamented with Corinthian pilasters, between which are circular wreaths containing, in the case of the King, sculptured figure subjects, and, in the case of the Countess, armorial bearings. The recumbent figure of the latter, however, is surmounted by a brass canopy of ogee outline and filled with flowing tracery, showing that its designer clung to the old style, though he has mixed it up with what is classically known as the "money enrichment," on the quasi-buttresses supporting this canopy [Illustn. xix. figs. 70, 71]. In the monument of Henry VII, he and his Queen are represented as lying side by side, with the hands raised and folded in prayer, as are also those of his mother; and thus differ from Dr. Young's. The architectural details are all Italian, and are executed in white marble, black marble and brass for the capitals, enrichments and scroll work. With the exception of the inclosing metal screen, which is Gothic, we have here a monument carried out, with complete Italian detail, to the desire of Henry VIII, who thus showed his appreciation of the imported style.

The next monument, dated 1524, is to Bp. Ruthall, who is not treated to the new fashion, but whose recumbent figure and the pedestal it lies on are uniformly Gothic.

Edward VIth's monument, if reckoned by the date of his death in 1553, would come next, but reckoned by the sum in substraction placed on it, I believe by Dean Stanley, we learn that it had been removed in 1643, though no date is given of its original erection. There are angle piers, "columnæ" as the Dean calls them, with sunk panels containing the most exquisite floral ornaments in very low relief, arranged just conventionally enough to satisfy architectural taste, but otherwise naturally treated [fig. 72].

The next monument to Anne of Cleves, who died in 1557, is interesting as introducing us to an acclimatized treatment, so to speak, for it cannot be called Italian, for here we have the surmounting converging and diverging scrolls, which were carried to such an elaborate pitch in Elizabethan work. This monument is said to have been executed by an artist brought over from Cleves for the purpose, which indicates a sympathy between minds in the same degree of latitude [Illustn. xix. fig. 73].

Sir T. Parry, who died 1560, is merely recorded by a grave stone.

The next is Lady Jane Seymour, whose wall-tablet shows the beginning of a style of ornament quite in keeping with the taste of the age for jewellery, the large convex moulding of the cornice being ornamented with cabochons and circles alternately, and strung together as a necklace might be [fig. 74].

Dr. Bill, who died 1561, again shows us a plain Gothic pedestal and capping.

The Duchess of Suffolk, who died 1560, lies on a pedestal divided into three panels at each side and one at each end, like that of the Countess of Richmond, but instead of circular wreaths we have here an inner rectangular border, enriched with the egg and tongue, and surrounding lozenge-shaped armorial bearings. The angles have fluted Doric columns, the sides have pilasters, whose sunk faces are decorated with strap-work [fig. 75].

The next monument to Lady Catherine Knollys, who died in 1568, is a wall-tablet, surmounted by a broken pediment, the note-worthy feature in this case. A circular coat of arms occupies the central space. The tablet is supported on a continuous bracket or podium of ogee section, the capping moulding of which is overlaid with the favourite jewels or cabochons, thus made to do duty in a new position [Illustn. xix. fig. 76].

We now come to the first of those vast wall-monuments which start from the floor: this is to Sir Richard Pecksall, who died 1571, consisting of a central arched recess, in which the Knight, in full armour, except his head, kneels facing eastwards, while his two wives kneel in lower arches, one on each side of him; one of them faces eastward behind him, and the other in front of him, to be polite, also faces him and therefore westwards. Below these three arches there is a podium, the centre of which is occupied by the four daughters of the first wife, and the sides by inscriptions. This again rests upon a stylobate with more inscriptions, and the whole upon two steps. The feature to notice is the introduction of deep key-stones to the arches [Illustn. xx. fig. 78]; they seem to have fallen out of use, as we do not find pronounced examples in subsequent monuments. The design of this shows a want of experience in its treatment, which is accounted for by its being the first of its kind.

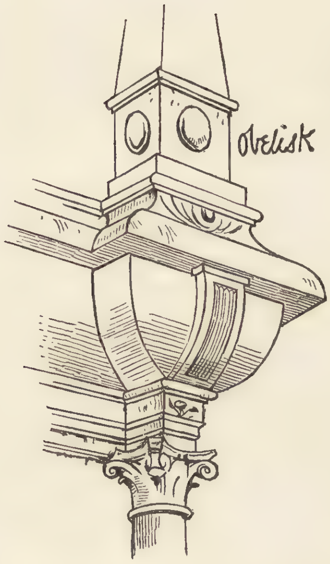
The next monument, to Margaret Douglas, Countess of Lennox, a lady who could count amongst her relations no less than fourteen kings and queens, and who died in 1577, is a pedestal monument, but it differs from the former ones in being raised upon a podium, projecting sufficiently around it to carry kneeling figures of her children and obelisks, of which this is the first appearance, at the angles. This is a remarkably fine monument [Illustn. xix. fig. 77].

We will just step over to St. Margaret's Church to look at a small tablet bearing the same date, 1577, to Cornelius Van Dun, consisting of a head and shoulders placed in a circular recess, surrounded by the inscription, and contained within a frame of what may be called repressed scroll-work. On the top are two hour glasses, which afterwards played such an important part in the decoration of monuments [Illustn. xx. fig. 79].

A digression to All-Hallow's Barking Church shows us, in the monument to Hieronymus Benalius Berguni, 1583, the surmounting coat of arms and scroll-work increased in size, and, within the monument, swags of fruit and flowers.

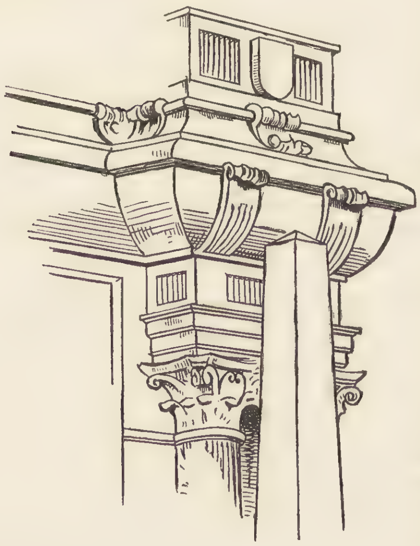
Returning to the Abbey, we may pass the monument of Captain W. Thynne, 1584, which offers no new feature; and that of Lord Russell, 1584, presenting a bulbous tomb and effigy lying for the first time (?) on its side [fig. 80]. Under a large arch is that of the Marchioness of Winchester, having a capping moulding similar to the last. The next is to Sir Thomas Bromley, 1587, who reposes under an arch, the soffit of which is enriched with alternate square and circular raised panels, suggestive of jewellery, and with the spandrils filled with Angels, blowing trumpets, and Fame, who is borne by a bulbous pedestal enriched with huge jewels [fig. 81].

The next, to the Duchess of Somerset, also 1587, shows a double composition: the lower one, consisting of an arched recess flanked by Corinthian columns, now for the first time in pairs, and over the cornice a second order of smaller coupled Corinthian columns, flanking a coat of arms, and the whole surmounted by a heraldic castle. In this case, each pair of columns carries an obelisk, making up a pleasing group. The monument, including the Countess of Oxford, 1587, and Lady Burleigh, 1589, also presents coupled columns, those in the lower stage being spaced wide enough from each other and from their pilasters to admit

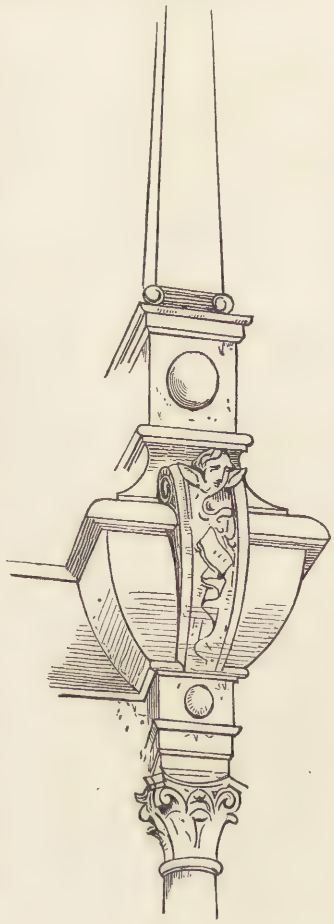


of kneeling figures, all facing eastwards, and flanking the central recumbent figure of Lady Burleigh. Here, for the first time, we find balusters to fill up the wide spaces between the pedestals of the columns. The upper stage contains a central recess with a kneeling figure, presumably the Earl of Oxford, who married Lady Burleigh's daughter.

Stepping again over to St. Margaret's Church we may see, in the monument to Blanche Parry, 1589, to what delicacy the representation of jewellery was sometimes carried, as shown in the Illustration [xx. figs. 82, 83.] Here too we come, for the first time, to the characteristic effect produced by returning the convex shape of the bracket under the pilasters. Hitherto we have seen the pilasters carried on straight-sided brackets. This return of the convex moulding quite alters the character of the work, and is found in several of the succeeding examples, such as the next one, to the Countess of Sussex, 1589, where this double convex moulding is used as a cornice, and is ornamented with a projecting strip to carry the eye from the centre of the column to the centre of the obelisk over it [woodcut].



Passing by Lady Cecil, 1591, and Lady Ross, 1591, resting on her elbow, we find in the huge monument of Henry Carey, Baron Hunsdon, a further development of the strip on the convex cornice, it is here turned over just under the projecting moulding which surmounts it; whilst the next monument to Sir John Puckering, 1596, shows this strip boldly passing beyond this projecting moulding and scrolled over it [woodcuts].



These steps, if they be really successive, point to the kind of development that one finds in any growing style, and indicate a healthy freedom from slavish adherence to mere precedent. This use of a convex pedestal is carried still further in the case of Sir John Manners's monument at Bakewell Church.

The monuments to Sir R. Bingham, 1598, come next, and in the same year we have again a two-storeyed one to the Countess of Hertford. This introduces us to the pair of arches

in place of the single arch, seen hitherto, with the result that they spring from a higher level and from loftier pilasters. Thomas Owen, 1598, rests upon his right elbow [fig. 84] under a single arch flanked by Corinthian columns, standing in front of pilasters, the space occupied by the capitals being carried across the monument as a kind of under-frieze which is, classically speaking, naughty but rather nice. The back of the arch is filled up with strap-work contrived to include little niches containing figures of children which are decidedly nice [fig. 85].

The first step into the 17th century introduces us to a new style of composition, namely a lofty monument standing clear of the wall, and covered with a canopy, as distinguished from the pedestal monuments or altar tombs that we have seen hitherto. This is to Lord Norris, 1601, who is represented lying under a canopy surrounded by his six sons [fig. 86]. Finer or more life-like specimens of sculpture can hardly be conceived. The canopy is flat, forming the cornice of a Corinthian order, and is supported on the friezes and architraves of four pairs of columns dividing the composition into three, a son on each side, occupying the respective spaces, and the end pairs being stiffened each by a connecting arch. Over the central space is a square pedestal surmounted by a figure of Fame. The whole is by no means a satisfactory composition, and suggests the idea that, if the figure of Fame were to become too vigorous, he might shake the monument down. There are two other monuments of this year, 1601: Dr. Goodman, who good-naturedly takes his kneeling position in the wall-arcade of the abbey, and Lady Russell who sadly sits on a circular pedestal (the first we have seen), resting her right foot on a skull, and pathetically hanging down her left hand, of which she pricked a finger with a needle which brought on lock-jaw and her death.

Bearing Lord Norris's monument in mind, some light is thrown upon the next, which is perhaps the most important monument of the period, namely that of Queen Elizabeth. Here, again, is the triple composition formed by the four sets of columns—a central column, however, taking the place of the arch at each end of Lord Norris's monument. It is needless to say that there are not six sons to occupy the three spaces between the columns on each side, but their place is fairly occupied by four lions, each of which carries a corner of the slab on which the effigy of the queen lies, her hands holding the ball or sceptre instead of being folded in prayer. The canopy, however, shows the chief improvement upon Lord Norris's monument; here the complete entablature rests upon the end groups of columns, but is boldly cut asunder in the centre to make room for an arch and a barrel vault, which again carry a square pedestal ornamented with royal arms and surmounted by the heraldic lion. The triangle formed by the spandrils over the arch, and the complete entablature of the order, give a feeling of stability that is wanting in Lord Norris's case. This monument is said to be by Maximilian Poutrain, and to have cost £965. besides the stone wall, white marble and touch stone, in 1609. The date given by Mr. Papworth is rather earlier. Anne Kirton who also died in 1603 is commemorated by a simple wall-tablet. Sir Thomas Hesketh, 1605, lies in a monument which is the counterpart of Thomas Owen's.

The next monument, 1606, is interesting but hardly architectural, as it represents Sophia the infant daughter of James I in a cradle; near it, is the effigy of Mary, another of his daughters resting on her left elbow, with mourning *amorini* at the corners of the pedestal.

The treatment of Queen Elizabeth's effigy resting on a slab supported by lions, is further carried out in the fine monument to Sir Thomas Vere, 1608, whose armour lies on a slab borne

upon the shoulders of knights kneeling at the four corners. This is justly considered to be one of the finest specimens of sculpture in the Abbey.

The monument to Mary, Queen of Scots, corresponding in form and position with that of Queen Elizabeth, now claims our attention, more than twenty years after her violent death. The central archway is larger in proportion than that in the companion monument, and consequently overpowers the composition, though the grouping of the columns as seen from the sides is far more pleasing. There is a good deal of space "to let" beyond that occupied upon the main pedestal by the effigy, which, again, lies on a bulbous pedestal of its own. This monument is said to be by Cornelius Cure [Illustn. xx. fig. 87].

The next monument, to Isaac Casaubon, 1614, introduces us to a pediment not only broken but curled, to allow a central panel to rise between these curls, which central panel is surmounted by what appears to be a broken pediment, but a close examination reveals a couple of books, in memory of this learned man, laid at the angle of a pediment; they again leave a central space through which a something rises to carry a coat of arms; all the details of this monument are peculiar. It has been attributed to Nicholas Stone [fig. 88].

The next monument to the Earl and Countess of Shrewsbury, 1617, shows the influence of the monuments to Queen Elizabeth and Mary, Queen of Scots, applied to a single arch composition, the arch springing like theirs, from the cornice of the entablature of the main order, instead of from lower pilasters as in the wall monuments hitherto mentioned. This monument projects far enough to admit of a small arch in each end, in one of which the kneeling figure of a daughter is introduced. The general effect of this composition is not so pleasing as that of the former ones, owing to the thin abutment to the arch [fig. 89].

A new feature meets our eyes in the monument of Sir George and Lady Elizabeth Fane, 1618, who kneel side by side, facing out of the monument under a projecting canopy, from which a pair of curtains is drawn aside to reveal them; figures of goddess-like angels and of *amorini* disport themselves in various places. The next couple [Illustn. xxi. fig. 90], Sir Christopher Hatton and his Lady, 1619, occupy quite a novel position, reclining on the sloping lines of a broken pediment, like Michael Angelo's Night and Morn, with the additional comfort of cushions for their elbows. They are surmounted by two *amorini*, sustaining a coat of arms by means of drapery in front of a pair of curtains drawn right back.

It is pleasant here to make a little excursion to All-hallows Barking Church, where we find Francis Covell and his wife, 1621, kneeling, with their hands folded, in a pair of arches, and facing each other. To return to the Abbey: the monument of the Earl of Exeter, 1622, is a pedestal something like the earlier ones, except that the pilasters are coupled, and is chiefly remarkable for the blank space left for his second wife, who would not allow her effigy to be placed to his left.

Francis Holles, 1622, sits in Roman armour on a circular pedestal. Bishop Duppa's monument, 1622, I could not find.

Running over to St. Margaret's, we find Francis Egiocke, 1622, kneeling in full armour, under a curtained canopy, quite in the fashion [fig. 94].

The monument of W. Camden, 1623, introduces us to a half-length figure over a tablet. That to Sir R. Coxe, of the same year, is also a tablet.

Another visit to St. Margaret's shows a wall tablet to E. Reynolds, 1625, which is

interesting as showing a system of making mouldings stop against something and start fresh. We have here also a new character in the lateral scroll-work, quite distinct from the earlier treatment [fig. 95].

Sir George Holles, 1626, has a broken scroll pediment with weeping angels sitting thereon [fig. 91]. The point to be observed in this monument is the representation of men in *plate* armour in the central panel, while the monument is surmounted by a warrior in *Roman* armour wearing a helmet with a vizor. Evidently about this time views of art had got rather mixed. Of the Duke of Buckingham, 1628, I have no note.

Viscount Dorchester, 1631, reclines easily on a pedestal in front of a common-place monument flanked by Ionic columns, an order not hitherto favoured in this manner.

Jane Hill, of the same year, kneels on a pedestal, there being small *separate* groups in the wall. M. Draiton, also of the same year, 1631, shows us a new vagary in the design of its pediment, which drops in the centre under his bust [fig. 92].

The next monument to the Countess of Buckingham and her husband, Sir George Villiers, is interesting, as being the first specimen of a kind of tomb that became very common in church-yards for more than a century, and consists of curved angle-blocks stopped against square central panels in the ends and sides [fig. 93].

Sir Thomas Richardson, 1634, exhibits in another most peculiar form of pediment mixed with swags of drapery.

Ben Jonson's tablet, 1637, is remarkable for its simplicity. Each monument has hitherto shown some interesting architectural variety, but architecture is now becoming subordinate to portrait sculpture. In proof of this I will select a few examples.

The monument to the Duke and Duchess of Richmond, 1639, has a canopy borne by weeping caryatid figures at the four corners [fig. 97].

On T. Carey's, 1645, the inscription is written on the drapery.

Colonel Popham and his Lady, 1651, stand in elegantly sad attitudes, each resting an elbow, of course on a cushion, resting on a central pedestal, the canopy over their heads resembling a tent bedstead, with the curtains drawn back over Ionic columns [fig. 96].

Esme Stuart, 1661, is satisfied with a pyramid and an urn, the latter article destined to play an important part in future monumental art.

George Monck, Duke of Albemarle, 1670, and erected 1720, stands in full armour in front of a naval trophy, while a coolly clothed young woman sits alongside weeping.

Sir Charles Harbord and Clement Cottrell occupy a double monument, 1672.

The designs just about this date are far quieter, for a time, than they had been.

That to the Duke of Newcastle, 1676, is indeed quite proper. Inigo Jones had been setting an example, and restrained the former exuberance.

The monument of Francis Lord Cottington, 1679, must be mentioned as an exceptional design, almost entirely in black marble. There is a delicacy and refinement about this that indicates a peculiar source of inspiration.

Thomas Mansell and William Morgan, 1684, another double monument, introduce us to twisted columns.

Sir George Saville's monument, 1695, is a very thin-looking affair, more suggestive of joinery than of masonry [fig. 98].

I will finish the list with the monument to Lady Grace Gethin, 1697, who is well taken care of by an angel on each side of her, holding a wreath and a crown over her head with one hand, and holding on to an Ionic column each with the other hand.

In the list that I have just enumerated I have pointed out some fresh feature in each example, and if these be as successive as their dates would imply, a certain progress (whether in the way of improvement or otherwise) may be noted, and now the question is whether a corresponding progress may be noted in the contemporary architecture.

I should premise, however, that the architecture of this period often consisted of two elements, one for the structure generally retaining the old established Gothic treatment of the walls, and door and window openings, and the other for the more ornamented features, such as the chimney pieces and entrance porches or frontispieces. These would be based upon the same system of design as would be followed in the sepulchral monuments, and would moreover be employed only by those who were rich enough to afford such luxuries; therefore a comparison of this portion of the architecture with the monuments of the 16th and 17th centuries may be fairly instituted.

Ecclesiastical architecture would naturally cling to the old style, as may be seen in Bp. Longland's chapel at Lincoln Cathedral, erected 1521-24, that is, within a year of the date of Layer Marney in Essex, 1525, which is one of the earliest instances of the application of Renaissance detail to domestic architecture.

In Chelsea Church, however, we find a most interesting proof of the fearless manner in which Renaissance art invaded an old building, namely, one of the two capitals inserted under the arch opening into the south chancel aisle. The date carved upon it, 1528, is strongly suggestive of Hans Holbein's visit to Sir Thomas More, the design being fanciful rather than strictly architectural, and therefore like a painter's idea.

Sutton Place in Surrey, 1529, shows an infusion, slight it is true, but perceptible, of Renaissance feeling in the terra-cotta details; such as may also be seen in Great Snoring Parsonage House, Norfolk.

I would specially mention Bp. West's chapel, 1533, in Ely Cathedral, and now pass to Hampton Court Great Hall, the roof of which, of the old hammer-beam form, seems to have been erected in 1536-37. The spandrils and pendants are of pronounced Renaissance character, and extremely elegant. The same year shows us another hammer-beam roof at Downamney, Gloucestershire, where the pendants again show the new influence. Of Nonsuch Palace nothing remains, but it seems to have been arranged for lavish display of the plastic art in panels, etc.

Hengrave Hall, Suffolk, in the same year, has an oriel window, over the four-centred Tudor arch, supported by corbelling that is alive with Italian *amorini*, who were displacing the old fashioned angels of English sculpture.

St. James's Palace, 1540, exhibits Renaissance work ascribed to Holbein.

To go to another county, we find Weston Hall, Warwickshire, 1545, containing an enriched frieze, in a style that is already settling down into an English version of Renaissance art. Still further north, at Edzell Castle in Scotland, 1553, the Renaissance leaf flanks the more or less Gothic window-heads.

Middle Temple Hall, 1562, contains a sumptuous example of Renaissance Screen-work.

In 1563 John Shute's book, *First and Chief Grovndes of Architecture,* is published, and is, unintentionally of course, one of the funniest bits of reading to be found in our Library, which possesses one of the only two known copies of this edition in England. He speaks of "Plinthus" as if he were an intimate friend, and he expounds the proportions of the orders by comparison with human figures, to which it is impossible to discover the faintest resemblance.

In 1567 we have Longleat, Wiltshire, ascribed to John of Padua, an Italianized English house, which stoutly retains its stone mullions and transomes, as did all our houses, even in one instance ascribed to Inigo Jones. This is a feature curiously ignored in Hakewill's little illustrated Essay on Elizabethan Architecture, where the windows are all shown as one large light.

The same year, 1567, shows on the Gate of Honour at Caius College, Cambridge, ascribed to Heave of Cleves; here the orders are made to stand upon and around a four-centred arch, which bravely holds its own in the centre, and does not go badly with the parallel lines of the surmounting pediment. The balusters between the plinths of the upper order are earlier in date than those mentioned in the Burleigh monument.

Kirby Hall, Northamptonshire, 1572, shows the middle and upper orders carried on trusses or brackets, as is so often the case in monuments. It is represented in an excellent drawing, contributed to the *Architectural Association Sketch-Book,* by Mr. Vialls, who has indicated the desolation of Kirby Hall by a stray cow being driven out of it. Many other illustrations of my subject are to be found in this same valuable collection of sketches and measured drawings, which fill up some of the gaps left by the better known and admirable works of Nash, Richardson and Shaw.

Rothwell Market House, 1575-80, traced from Mr. Gotch's careful work on Sir Thomas Tresham's Buildings, shows us a treatment which is characteristic of the architecture of this period, especially, perhaps, in John Thorpe's designs, but curiously absent from the Abbey monuments, I allude to the raised bands on the columns, suggestive of their being bound with iron, and to the other ornaments often laid upon them.

The subject would be incomplete without some allusion to half-timbered buildings, of which Leys Farm, Weobly, dated 1582, is an example.

Brereton, in Cheshire, 1585, shows an early example of pilasters diminishing downwards, which are also happily absent from the Abbey monuments. In this case the Renaissance treatment has been incorporated with the Gothic outline and windows more completely than is usual.

At Audley End, or Inn, 1603-10, we find two porches, one for use and the other for uniformity, and consisting of two storeys of correctly-designed architecture, applied to the mullioned and transomed front of that large building. The upper cornice is carried on brackets, such as one finds in the Abbey monuments.

Bramshill, Hants, 1607, has a frontispiece ornamented with three orders of diminishing pilasters, a fanciful piece of work of James the First's time, again plastered on to an exterior which might have been called Gothic without it. These diminishing pilasters get over the difficulty of making the upper pedestals, or "Plinthus," as Shute would call them, overbear the line of the order below.

A farmhouse that I sketched at Burwash, in Sussex, dated 1610, shows how completely free from Renaissance influence such comparatively unimportant buildings still remained. E. B. Lamb's *Studies of Ancient Domestic Architecture* is devoted to the illustration of houses, which are also Gothic or nothing in style, of a higher grade than this. The interior woodwork may, in some cases, tell a different tale, but that is not exactly architecture.

Wadham College, Oxford, 1610, is an early example of an almost complete set of correct superimposed orders, struggling with Gothic canopies and four-centred arches, a struggle which is manfully maintained in the tracing of the three-light windows and elsewhere. This attempt to innoculate the national style with Renaissance lymph must command our respect if it cannot excite our admiration.

A peep into the Highlands at Craigievar Castle, 1611, naturally reveals the spread of the fashion into the country of which our James Ist was their James VIth. The ceiling is a bold example of an art that was carried to a great perfection during this period.

Dropping down to Barmingham Hall, Norfolk, 1612, we find an early example of pediments over the mullioned and transomed windows of the whole front as well as over the door, thus giving greater unanimity to the design. The public schools at Oxford however, 1613-19, show that such a revolution was not to be tolerated in that ancient home of learning, though the windows are surrounded by the correct number of fairly correct orders. It is noteworthy, however, that the cap of "Plinthus" is respectfully raised to be continued as an architrave around the *jambs* as well as heads, and therefore differs from the drip-stone dropped from above.

Lingfield, Surrey, 1617, shows us the kind of vagaries that may have been committed by a designer, who had not drunk deeply of the new Pierian spring—his egg and tongue enrichment is treated in a most indigestible manner.

Aston Hall, 1618-31-35, still shows us an entrance of Renaissance design, embedded in a composition of Gothic windows. Here the broken pediment is such as we should not be surprised to find on a monument of this period.

Inigo Jones, however, was now influencing architectural taste, and while playful, one might almost say "dodgy," in detail, was far too well versed in classic work, ever to do anything absurd. It is interesting to note in Brympton Manor House, Somerset, 1615, ascribed to him, an acceptance of the old style of mullioned and transomed windows surmounted by his everlasting alternate straight and curved pediments, and surrounded by an architrave moulding similar to that employed by him at Whitehall Palace.

York Stairs, 1626, is an example of his work which would be better appreciated if it were not buried up to its knees in the ground of the Embankment Gardens.

The work attributed to Inigo Jones at Great St. Helens, Bishopsgate, 1633, exhibits his ingenious fancy, and may be compared with those monuments in which I pointed out the custom of stopping one moulding against other more projecting features.

University College, Oxford, 1634, is a striking example of clinging to the old love, the spandrils, above the four-centred archway, containing still almost the only Renaissance details, as they did a century before at St. James's Palace. Inigo Jones, however, was not afraid of carrying his style into this conservative city, as may be seen in the porch of St. Mary's Church, ascribed to him. Nor did he shrink from setting his mark upon a building that has already

been pointed out as an example of the Renaissance style, namely Kirby Hall, to which he is said to have added a window and balcony.

Hall-i-th'-Wood, Lancashire, 1648, is again Gothic, with a few unimportant details in the advanced style.

A doorway, that I sketched from a house at Bristol, might be mistaken for the work of half-a-century earlier, were it not for the date carved upon it.

The Alms-houses at Maidenhead, 1659, are, I think, free from Gothic feeling, and the inscription tablet is like a monument of this period. Lambeth Palace, on the other hand, though in London, shows in the work of 1663 the "old mixture as before." Deptford Alms-houses, 1670, are quite as Classic as those at Maidenhead.

The heads of doorways in Yorkshire, such as that at Settle, 1671, exhibit a fanciful treatment, which it is rather difficult to allot; but, dipping into the next century, we find at Clapham, in the same county, a door-head with drip-stone that would be called Gothic.

Yet another doorway at Hastings, dated 1682, would as readily be called Classic in spite of the four-centred arched head and jamb mouldings.

The works of Wren during the end of the century establish, beyond a doubt, the character of the style adopted for important works. Upon a review, therefore, of the architecture and monuments of the 16th and 17th centuries, I think it will be found that, while the latter rarely receded from any advance that had been made in style or treatment, the former is not to be depended upon for any consecutive development of style in all, or even in the more important, buildings erected in England.

The monuments, in my humble opinion, command our deep admiration during the reign of James Ist, and hardly ever mar the beauty of the architecture in which they are set. The sculptured figures are—not only in London, but in many distant examples—of the highest excellence, and, what is of more importance in my view, they were completely modern in treatment at the time that they were executed.

The falling off to Roman warriors and to heathen gods and goddesses was, I venture to think, as lamentable as the present fear either to represent our heroes in the costume of our day, or, by gentle degrees, to make that costume sculpturable.

EDWARD J. TARVER.

[Remarks by Wyatt Papworth, *Fellow.*]

Whilst engaged in compiling my recent pamphlet,* I found that there were very few traces of the names of the designers of the buildings or of the monuments; in some few cases I did come across a monument to which a name was ascribed. As regards buildings, for instance, John Thorpe's name and Inigo Jones's name are put to a large number; but I very much doubt whether their names should be applied to many of the buildings. That Nonsuch Palace was designed by Tito del Nunziata was only a supposition of the late Sir Digby Wyatt. It was a clever supposition also of his, that the name of the palace may have been derived from that of the supposed architect, who appears to have been one of the king's three serjeant painters! In regard to Inigo Jones, his name has been put to an immense number of buildings, and at

* *The Renaissance and Italian Styles of Architecture in Great Britain, during* 1450-1700, 8vo. Lond. 1883.

the time his biography was being written for *The Dictionary of Architecture,* I took the trouble to trace almost every building attributed to him, and in that article will be found several lists—first, his acknowledged designs; second, buildings attributed to him; third, others attributed to him without any grounds; and fourth, others begun and finished after his death, and with which he could have had nothing to do. Then there is another point, I think, that requires more elucidation, and that is, Who were the authors of these monuments before us? I think that they were all done by *carvers,* or *sculptors* as we now call this class of artists. Sculptors designed and carved them, but the buildings were designed by architects; and I do not think the monuments were designed by architects. Queen Elizabeth's monument was carved by Maximilian Poutrain, *alias* Coulte or Colt—the King's sculptor by warrant —and he probably designed it. The style of work, too, seen in the country monuments, seems to me to be of a very different character, for there is, of course, more real art in this series, illustrated by Mr. Tarver, than in many others seen in the country, a number of which were, however, carved in London and sent to the locality, for occasionally we do obtain that little bit of information. John Thorpe, whose book of Drawings is in Sir John Soane's Museum, has been of great interest to me for many years, during which I have endeavoured to find out who he really was, but excepting that I have seen a notice of a plan, dated 1590, of Eltham Palace as made by him, his name has not been found in any reliable book, so that, unless it could be recovered in some of the records—the government records—I do not know how we shall get to know more of him. The earliest building that is attributed to him is of the date of 1560, and the latest 1612—that is, about fifty years, a period of time that seems rather long to give to him. The arrangement in date of the use of the orders of architecture in the monuments before us is curious, and the introduction of the Ionic order, commencing at so late a period, looks as if it required a little more research to ascertain whether that was really the case, or whether, in the instance quoted, it may be merely accidental.

WYATT PAPWORTH.

[Remarks by C. Forster Hayward, F.S.A., *Fellow.*]

Such has been the destruction continually going on of late years that it has become now a work of real value to preserve records of the design, and especially to take note of the architectural details, as Mr. Tarver has done, of such of these fine monuments which remain to us. In several churches where the monuments are falling into decay, the churches themselves have been left by the towns which they served, being now absolutely isolated from them, whereas formerly they stood in the midst of houses. Layston, in Hertfordshire, at the present time, contains monuments of the individuals who used to live around the church, where there is not now the sign of a house at all. The town is now called Buntingford, standing in two or three parishes.

I am a little surprised the Paper did not allude to the introduction of the new material, terra-cotta, at the early Renaissance period, especially because of the reference to the tomb in the Rolls Chapel as one of that style, which is also an example of the earliest introduction of terra-cotta as well as of Italian detail. But I would refer particularly to Layer Marney Hall, in Essex, as one of the very earliest and best buildings in this material of terra-cotta; and to

another building (to which also Mr. Tarver referred), of rather later date, Sutton Place, near Woking. At Layer Marney, the windows are large, and with a kind of tracery in the heads, which, instead of being Gothic-formed, is composed of dolphins' heads and tails, while the mullions are pilasters with arabesques in sunk panels on the sides. The parapets themselves are formed of dolphins, as the tracery heads. Later on in date—at Sutton Place—the terra-cotta windows are perfectly good Tudor architecture, and have the cinqfoil and trefoil cuspings in the heads of the lights quite as usual in Gothic work, while the other details, such as the hollows of the mullions, transoms, cills and tracery, are as full of Italian work as they can possibly be. It is most curious to see how the wave of Italian art seems suddenly to have rolled into this obscure part of Essex, which I daresay few of you have visited, but which is well known to me, because some of my own family lived in that neighbourhood.

I am not aware that this Italian terra-cotta was ever developed to anything like the same extent in any other part of England, and later on the builders went back, for a time, to the earlier forms, and never seem again to have designed to such an extent with this particular kind of Renaissance detail. At a recent visit to the Priory Church of Christchurch, Hants, I was much struck by noticing the mixture of Italian detail, superimposed upon Gothic construction, in the Chantry Chapel of the Prior Draper (1529),* and that of the Countess of Salisbury (between 1530-40).†: the one at the end of the south chancel-aisle, and the other on the north side of the choir at the east end, near the altar. These are two perfectly Gothic monuments of the early sixteenth century. They are quite within the first quarter of the sixteenth century; and while there is the perfect Gothic detail in every respect, as regards the masses, and the cinqfoil and trefoil in the heads of openings, there is introduced in the hollows and various other places, just as in the windows of Sutton Place (and especially in one particular ornament at the top of the cresting), a quantity of most perfect Italian work. Possibly the Gothic men and the Italian men worked side by side, each in their own style. One other set of tombs I should like to mention,—the tombs of the chancel at Arundel.‡ They are very peculiar, and some are said to be of terra-cotta. At the church at Layer Marney there are several monuments: one of them is particularly elaborate in Italian detail, executed in the finest terra-cotta, consisting of a recumbent figure under a canopy, forming an arch in the wall between the chancel and the north chancel aisle. Another earlier altar tomb I caused to be removed from the centre of the chancel, where it had been placed at some recent date, to its original position in the north aisle or nave of Chantry Chapel, when I had the pleasure of executing some restorations to this church, in the year 1870. The advantage of the study of these particular tombs and church is, that we know the date of the Italian details to be between 1500 and 1525, the first quarter of the sixteenth century, because the owners of the place died one after another, and there was no one left to give any further care or attention to the buildings, so they were never completed, although they remain in a sufficiently

* Inscription: "Anno Domini Millesimo quincentisimo xxix$_o$."—C. F. H.

† Executed on Tower Hill, 1541. A letter of the Commissioner to the King Henry VIII., says: "In " thys churche we founde a chaple and a monumet couriosly made of Cane stone pṛpared by the late mother " of Raynolde Pole for herre buriall whiche we have causyd to be defaçyd and all the Armis and Badgis to be " delete." In Mr. Papworth's pamphlet the date is given as *circa* 1516, quoting from the late Mr. Ferrey's Paper: TRANSACTIONS, 1863-64, pp. 130-146.—C. F. H.

‡ Date given in Mr. Papworth's pamphlet, 1524.—C. F. H.

perfect condition for study, owing to the goodness of the terra-cotta work. I should like to find out who it was that designed this terra-cotta and where it was manufactured—whether on the spot, or imported. If it was made in England to find the spot where the kiln was situated, and ascertain if any waste pieces or moulds could be discovered. If imported from abroad, one would have expected to find some record as to the men who designed or erected it.

Sir Thomas Weston, who built Sutton Place (like the Lords Marney who erected their Hall at Layer), was attached to the Court of Kings Henry VII. and VIII, and had continual intercourse with Italians and other foreigners; and one would hope that by further historical research there might be some chance of this question being solved.

C. FORSTER HAYWARD.

[Remarks by Francis T. Dollman, *Associate.*]

Mr. Tarver did not make especial mention of the various changes of posture that the figures in sepulchral monuments have from time to time assumed. We all know that, until the great religious convulsion of the sixteenth century, the figures were almost invariably recumbent, with the hands clasped in the attitude of prayer. The posture of the figures afterwards underwent a gradual but marked change. In the first instance the feeling of devotion does not seem altogether to have disappeared, for the figures were generally represented in a kneeling posture: the father, with his sons behind him, the mother with the daughters behind her (generally a very numerous progeny). This was afterwards succeeded by what was intended no doubt for an attitude of meditation, but which, it has been suggested, rather conveys the idea of a sufferer from toothache. After a time we come to the period of the long flowing wig and the Roman toga, and, still later, the sitting posture, such as, *exempli gratiâ,* we behold in the statue of Lord Mansfield, James Watt and many others in Westminster Abbey, St. Paul's Cathedral, and elsewhere. Last of all, the figure rose up into a self-asserting erect attitude. These, I apprehend, are the gradual changes that, since the sixteenth century, the figures in monuments have by degrees undergone. As regards canopies over monuments, I may observe that, in a church with which I am well acquainted, namely, the church of St. Mary Overie, Southwark—in what is now called "the Lady Chapel" (but which is in fact the retro-choir), there lies Bishop Lancelot Andrewes. His tomb was originally in the so-called Bishop's chapel at the extreme eastern end of the church. This, the veritable Lady Chapel, was pulled down in 1830, and Bishop Andrewes's monument was then removed to its present position. This monument, according to historical notices, had a very elaborate canopy, which was destroyed at the time of a fire at the end of the seventeenth century, and which did great damage to the east end of St. Mary Overie church. The bishop lies above ground in a leaden coffin within the sarcophagus. In the same church there are one or two mural monuments of the seventeenth century, which I will recommend to your notice, of Richard Bingham and others, which are well worthy of attention. I think, in connection with this subject, and supplementary to it, there is another matter deserving of attention, and that is, the gradual alteration in the characteristics of the inscriptions. Perhaps this possesses archæological rather than architectural interest, but it is equally entitled to notice. The "qui "pur l'alme de . . . priera, . . . jours de pardon avera," of the twelfth and thirteenth centuries,

was succeeded by the "cujus animæ propicietur Deus," which remained in general use till the Reformation. A modification of this still existed for some time afterwards, but ultimately gave way to the pompous and fulsome Latin inscriptions of the seventeenth century. Similar evidences of worldly pride and affectation ensued during the eighteenth century, till we come to the "affliction sore," &c., and the ribaldry which still exists to disgrace "God's acre" in so many places in England. I think that the changes of inscriptions might form an excellent and most interesting addendum to the study and illustration of sepulchral monuments.

FRANCIS T. DOLLMAN.

[Notes* communicated by W. Samuel Weatherley, *Associate.*]

In Mr. Papworth's recent and valuable pamphlet on *The Renaissance and Italian Styles of Architecture in Great Britain*, he gives "Arundel Church, Sussex, Terra-Cotta Tomb of Earl "of Arundel, 1524," and on the third page following "Tomb of Terra-Cotta of one of the "Earls of Arundel," but with the date "1544." I have not traced how the above statement originated, but possibly the best way to show that none of the tombs in "the Chancel at "Arundel" (commonly called the Fitzalan Chapel) are of terra-cotta will be to describe them in detail. In the centre stands the monument to Thomas, Earl of Arundel, son of the founder, and of his Countess Beatrix, 1415. With the exception of the plinth which is of black marble, the whole is in *alabaster.* This is illustrated in Blore's *Monumental Remains,* and "Stothard" gives the effigies. To the north of the above is the tomb or cenotaph to John Fitzalan, 1435, in *alabaster.* The effigy is given by "Stothard." On the south side of the chapel is the magnificent canopied tomb to William, Earl of Arundel, brother of the last-named, and to his wife Joan, 1488. Except the effigies, which are in stone, the whole is in *Sussex marble* (Petworth). An elevation of this is engraved in Mr. Tierney's *History of Arundel.* On the north side, opposite the preceding, is the fine canopied tomb of his son and grandson, Earls Thomas and William, *erected* in 1596. The whole, with the exception of the inscription plate, is of *Sussex marble.* It is a very interesting composition; the illustration [xxii. figs. 99-101] now given for the first time I believe, is from my measured drawing made last year.† The thin slabs used in this and in the monument of Earl William and his Countess Joan are about 5 inches thick, and the manner of building up is like the Chaucer tomb and the small altar tomb of William of Windsor and Blanche de la Tour in Westminster Abbey;

* During the discussion upon Mr. Tarver's Paper I said, with reference to the monument in Westminster Abbey to Sir Thomas Richardson, that I had always thought it to be the work of Le Sueur, the sculptor who made the statue of Charles I. at Charing Cross; that the effigy by Torrigiano in the Rolls Chapel still has distinct traces of colour, while those of his in Henry VII.'s Chapel are gilt. I also remarked that I had understood Mr. Hayward to describe some of the tombs at Arundel, in the Fitzalan Chapel, as of terra-cotta, but that my impression was that the thin slabs in which they are chiefly built are a kind of Purbeck. Since the discussion I have, at the request of the Secretaries, written the above Notes.—W. S. W.

† This and the illustration of Sir Thomas Richardson's Monument, Westminster Abbey, and that of an altar tomb from the church-yard, St. James's, Clerkenwell [Illustn. xxiii. figs. 104, 105], also accompanying these Notes, are reduced from a work shortly to be published, of which nearly 200 plates are printed, on Ancient Sepulchral Monuments, by W. Brindley and W. S. Weatherley, giving between six and seven hundred examples adapted to or as suggestions for our own time.

this last is *Petworth* marble, except the figures, which are alabaster. There is only one other monument in the chancel at Arundel, a large mural one, on the south side, to Henry, Earl of Arundel, 1579, last of his family; it is in *various coloured marbles.* The inscription on the monument to Earls Thomas and William explains, I think, how the dates given in Mr. Papworth's pamphlet have arisen, thus in the words "which Thomas died "Ano. XVIto. of Kinge Henry 8th, 1524" we find the first date, and in "which Willm died "Ano. XXXVto. of Henry 8th," the second "1544," *i.e.* 35 years added to Henry's accession. The inscription closes with "Placed for remebrance per Johe, Barone Lumley, 1596," this being the actual date of the monument.

About a generation onwards we find Thomas Howard, Earl of Arundel, collecting those magnificent specimens hereafter to be known as the "Arundelian marbles," and it is to his patronage that we owe in a great measure, and in some cases entirely, the work of such men as Inigo Jones, Vandyck, Hollar, and the sculptors, Stone, Le Sueur and Fanelli. To the last-named three our 17th-century monumental sculpture is largely indebted, and in Westminster Abbey we have examples of the work of each. Of Nicholas Stone's I will only refer to two, and one other which I believe to be his, though of this, as far as I can discover, no record exists: 1. Sir George Villiers and his wife Mary Beaumont, in the Chapel of St. Nicholas. In his own words he writes "In 1631 I made a Tomb of the right honourable lady the "Countess of Buckingham, and sett it up in Westminster Abbey, and was payed for it £560." 2. The youthful Francis Holles, 1622, in the Chapel of St. Edmund, son of the Earl of Clare, a figure of wonderful beauty and repose; and 3. the Earl of Middlesex and Ann his wife, 1645, in the Chapel of St. Benedict, which has so many characteristics of Stone's work that I am inclined to think it is his. Of Hubert le Sueur's (pupil of John of Bologna), we have at Westminster two authentic examples: 1. Sir Thomas Richardson, in the south aisle of the nave [Illustn. xxiii. 102, 103]; on the base is engraved "Huber le Sueur, Regis Sculp., Faciebat "1635." 2. Lord Francis Cottington, in St. Paul's Chapel; the upper part of this monument was executed during Lord Cottington's life and dedicated to the memory of his wife Ann Meridith, whose bust and wreath, &c., in metal are Le Sueur's work; the figure of his lordship below, put up about 1679, is the work of Francesco Fanelli. A mural monument to Sir Robert Aiton, 1638, in the ambulatory, is ascribed to Fanelli, but it is very probable the metal bust, after a portrait by Vandyck, is Le Sueur's, and that they worked jointly as in the previous case. Thomas, Earl of Arundel, died at Padua in the year 1646; he had designed his own monument and left instructions that "my owne figure, of white marble or brasse, should be executed by "Signor Francesco Fanelli." Neither one nor the other was ever done.

I do not think it is generally known that there is a monument of the 16th century in London, in the Church of St. Helen, Bishopsgate, to Sir William Pikering, exceeded only in magnificence by those of Westminster Abbey. It is under the easternmost arch of the north arcade of choir, and consists of an altar tomb, over which is a double canopy, resting on the entablature of the columns. The effigy of the knight is in sumptuous armour. Attached to the south face of the pier of the choir arcade, towards the west, is the inscription for this monument, inclosed in a beautiful little tablet of alabaster and black marble, &c. The inscription commences QVIESCIT HIC GVILIELMVS PIKERINGVS * * * * QVI OBIIT XIX MAII, ANNO SALVTIS A CHRISTO, MDXLII. I am giving a drawing of this tablet in the work referred

to in foot-note at page 53. There is against the east wall a mural monument to Sir Andrew Judd, Knight, who died in 1558, with a droll inscription, and a fine monument to Sir John Spencer and Alicia his wife, 1609, being an altar tomb and canopy, with effigies life size, at the feet of which is a figure kneeling towards the east, said to be that of their daughter, the great heiress who, for marrying Lord Compton, a young nobleman of slender wealth, was discarded until a reconciliation, planned and carried out by Queen Elizabeth, was effected. There are others of the 16th century, notably to Sir Thomas Gresham, in Sienna and black marble, with date 1579; and also work of much interest from the Church of St. Martin Outwich, now destroyed.

Before closing these short Notes I should like to refer to some less ambitious memorials to the dead in constant use during the 16th, 17th, and almost up to the end of the 18th, centuries. Of the churchyard crosses and altar tombs remaining to us most are well known and need no reference. Of altar tombs I would only point out the ingenious manner in which they are built up. What I wish more particularly to mention are the headstones, tablets and incised floor slabs. Headstones of considerable merit exist in nearly all our village churchyards, but the finest series in England, that I know of, are to be met with across country from Banbury to Moreton-in-Marsh, especially at Brailes. Four characteristics these headstones possess, whether English or Scotch: 1, thickness, most being 4 or 5 inches thick but champfered at the back; 2, good outline; 3, surface-work enrichments; and 4, a height rarely exceeding 4 feet. In the neighbourhood of London I may allude to very late types of the "Adams" period, some of excellent design. Nothing strikes one more in a modern cemetery than the meagreness of the attenuated headstones, which seem to have gained in height as they have lost in thickness, often mounting to the absurd height of over 6 feet with a thickness of 2 inches! no wonder some lurch this way, some that, giving a disreputable aspect to what should be a solemn scene. The excessive height of the stones makes a view around impossible, and practically converts a popular cemetery into a labyrinth of *paving stones* more intricate than the Maze at Hampton Court. Tablets of every conceivable variety can be met with; a more characteristic group of 17th-century ones than those at Chippenham could scarcely be desired. In the Priory Church at Brecon, South Wales, there exists a series of incised slabs, considerably over a hundred in number, dating from the 15th to the 18th centuries, of the most wonderful vigour, unique in their treatment, and retaining up to their latest examples the feeling of the best Gothic work. There are a few specimens in the surrounding village churches, but nowhere else in England have I met with slabs that could approach them in beauty, and, so far as I am aware, they have never until now been adequately illustrated.

It would far exceed the scope of these Notes to attempt to describe the treatment, at this period, of materials such as marble, stone, plaster, Sussex iron, &c., but I should like to refer to the very effective way of diapering and enriching columns, mouldings, &c., of Kentish rag, by slightly sinking the ground and polishing the relief surface, which becomes very much darker, producing a fine result with comparatively little expenditure of labour. Some good examples can be seen at Chilham, Kent. Memorials in wood are not uncommon, as at Chester and Prestbury, and we find the Clerkenwell type of altar tomb in brick, side by side with its stone neighbour, almost down to our own time.

W. SAMUEL WEATHERLEY.

[Notes communicated by R. Herbert Carpenter, *Fellow.*]

I had been hoping, in the course of Mr. Tarver's Paper, to hear more about architecture itself, and especially its transition from the Gothic to the Classic style, besides that shown by the examples of the tombs of Westminster Abbey. It seemed to me that there was not enough made of the great and abiding influence exercised by Inigo Jones in the earlier years of the seventeenth century, and I fancy it was because the name generally brings before our minds such prominent buildings as Whitehall or the portico of old St. Paul's—all purely Classic in style; but though he had in these earlier years begun to cast off his Gothic chains, and move forward, he was able to design in the old style in the most masterly manner. At this time of his youth (having been born in 1573) he was sent to Italy to study, by William, Earl of Pembroke, but he was only about 30 years old when he was invited by Christian IV. of Denmark to join his staff of art-workers, and to design his new palaces of Frederiksborg and Rosenborg, commenced respectively in 1602 and 1604. [Englishmen had worked for Danes before this at Throndjhem, and for Norwegians.] Frederiksborg has remains of the older castle of Frederik II. in its two round towers; it stands on islands in a lake, and has great quadrangles with several steeples and a commanding campanile. The style is simple, and of red brick with stone dressings; its windows are of three or two lights, with a transom, and all surmounted by pediments filled with a sculptured head; the storeys are divided by simple moulded bands, and finished by cornices and giant gable dormers, two or more storeys high, in the steep sloping metal-covered roofs. Curiously enough here, and at Christian IV.'s burial chapel, added at Roeskilde Cathedral, the chapel windows are three-light pointed ones, with intersecting tracery, for it was apparently then still difficult to dissociate church work from the Gothic style—indeed at Roeskilde the windows are put side by side with the superimposed orders with which the chapel is externally decorated. At Rosenborg the detail and the material is the same, and there are the same high gabled roofs and dormers—something like our Jacobean—but still the same severely uniform type of window. On the chief front are two towers and an octagonal stair turret, as also at Frederiksborg, where similar stairs lead to the great ball-room over the chapel. These are truely magnificent rooms in their decorations, and have been splendidly repaired since the disastrous fire of 1859, when the banqueting-hall, alas, was hopelessly destroyed. It is not likely, seeing that Inigo went over to England and was introduced by King Christian IV. to his sister, Queen of England, and to James I., that he completed his Danish works, though he would have probably settled all their details. There is a building, "The Fellows Building," at Christ's College, Cambridge, which, in its windows, parapets and other details, strongly reminds me of Inigo-Danish work. I cannot learn that there is any proof of its date. However, later [1612], Inigo went back to Italy again, and then, indeed, his style changed into that which more particularly marks him, and in which some of his more well-known works were carried out in England—but into this I need not follow him. My object has been rather to draw attention to that period of Inigo Jones's art when he worked more successfully, both in the spirit of the old style and of the new, than perhaps any man, and produced the most charming results.

R. HERBERT CARPENTER.

IV. ENGLISH MONUMENTS OF THE SIXTEENTH AND SEVENTEENTH CENTURIES. (XIX)

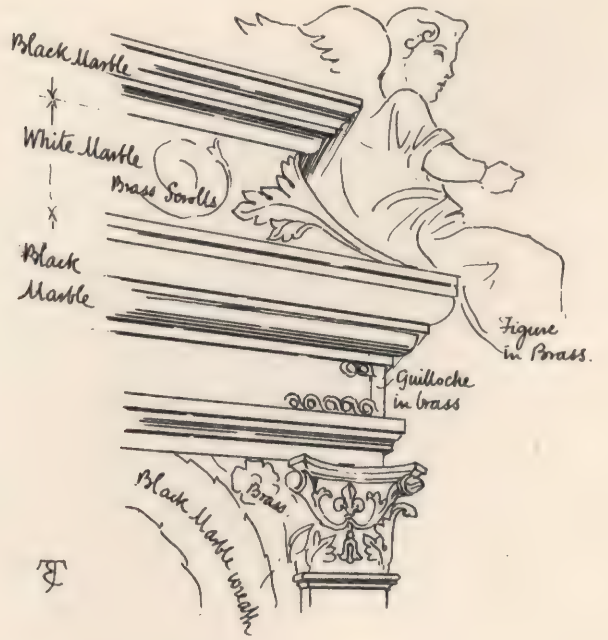


FIG. 70.

SEPTIMVS·HIC·SITVS·EST·HENRICVS·

KING HENRY VII, 1516.

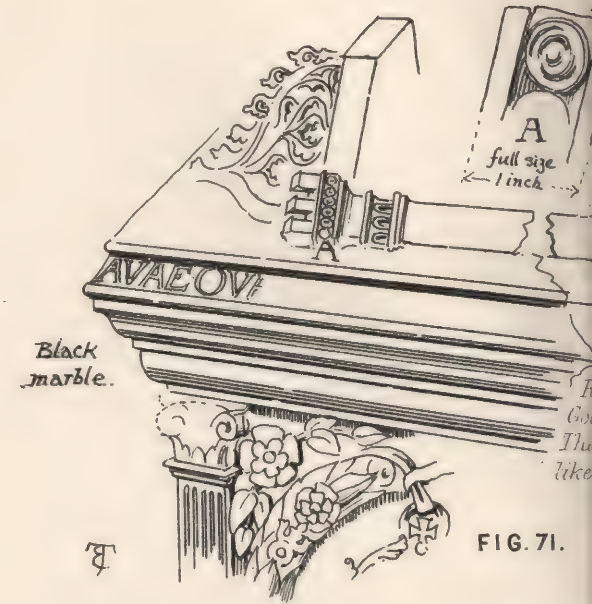


FIG. 71.

MARGARETAE·RICHEMONDIAE·SEPTIMI·HENRICI·
MATRI ·· MORITUR·ANNO·DOMINI·MDIX·III·KAL·J

MARGARET, COUNTESS OF RICHMOND 1519.

FIG. 74.

LADY JANE SEYMOUR, D. 1560.

FIG. 75.

DUCHESS OF SUFFOLK, D. 1580

The Canopy of the
cumbent Figure is
ic, except A. B. C.
Pedestal is Renaissance
hat of King Henry VII.

LII:

FIG. 72.

HÆ · COLVMNÆ · INTER · RERVM · NAVFRAGIA ·
ABREPTÆ · POST · CCXXXVII · ANNOS · LOCO ·
SVO · REPONVNTVR · A · D · MDCCCLXXX ·

KING EDWARD VI, D. 1553

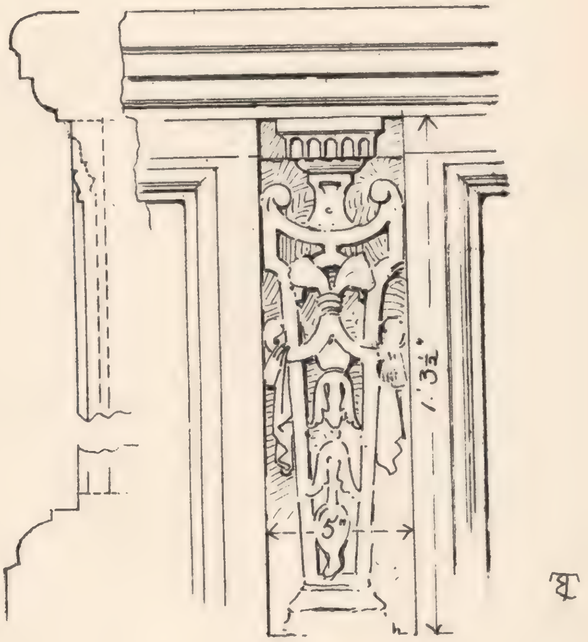


FIG. 73.

ANNE OF CLEVES, D. 1557.

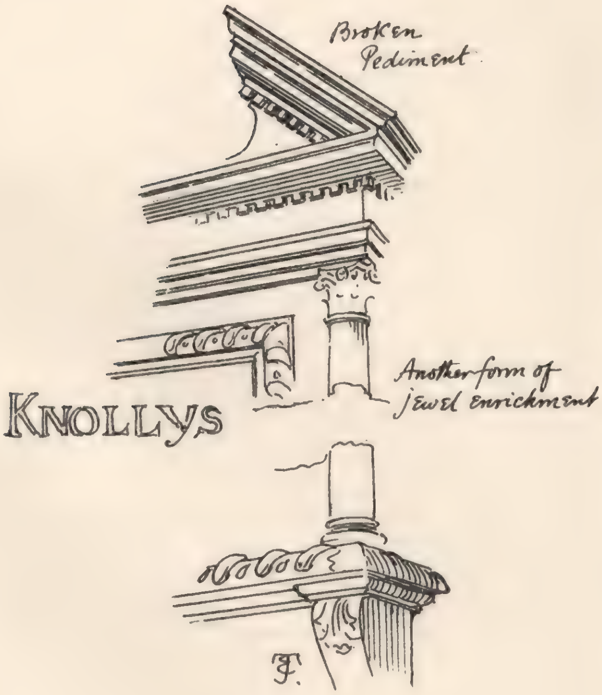


FIG. 76.

LADY CATHERINE KNOLLYS, D. 1568.

FIG. 77.

MARGARET DOUGLAS, COUNTESS OF LENNOX, D. 1577.

C. F. Kell, Photo-Litho. Castle St Holborn, London, E.C.

IV. ENGLISH MONUMENTS OF THE SIXTEENTH AND SEVENTEENTH CENTURIES. (XX).

RICHARD PECKSALL
D.1572.

FIG. 78.

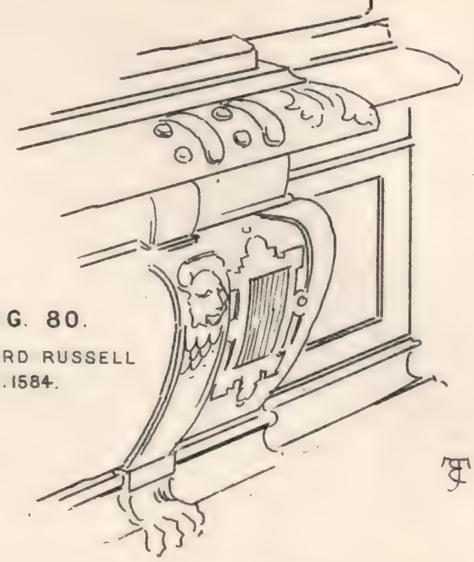
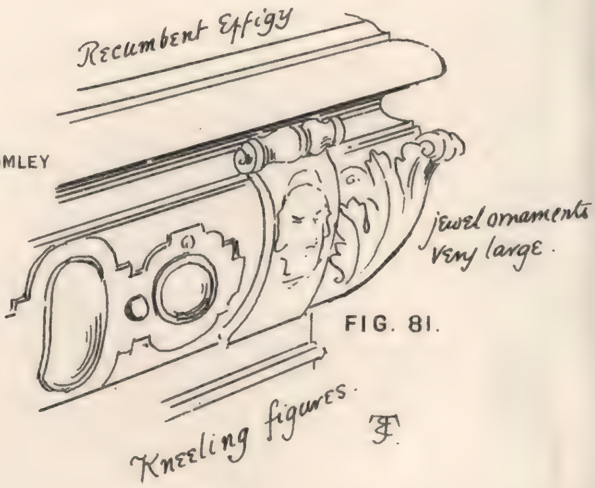


FIG. 80.
JOHN LORD RUSSELL
D.1584.

FIG. 79.

CORNELIUS VAN DUN, D. 1577.



SIR THOMAS BROMLEY
D. 1587.

FIG. 81.

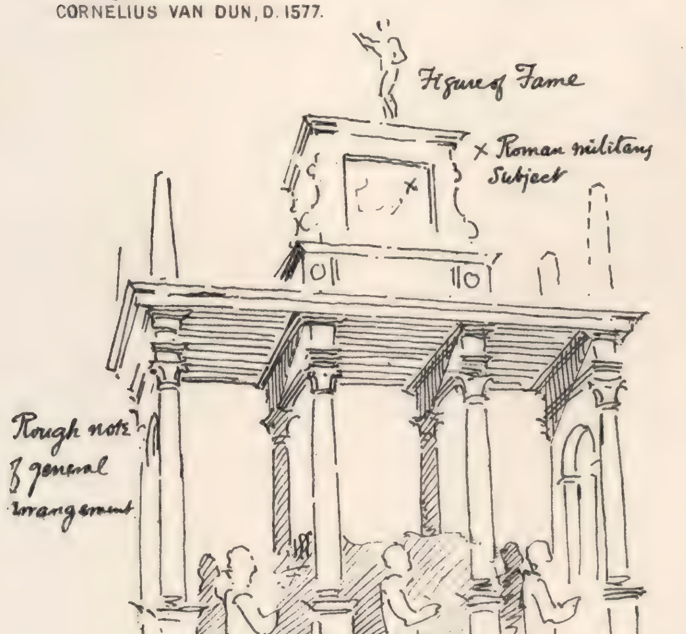


FIG. 86.

LORD NORRIS, D. 1601.

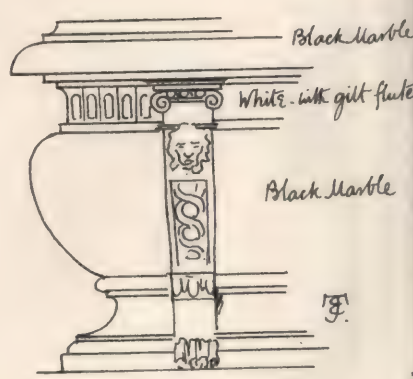


FIG. 87.

MARY, QUEEN OF SCOTS, 1612.

FIG. 82.

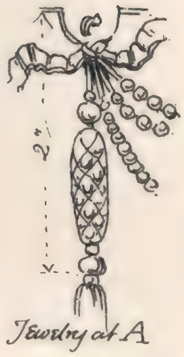


FIG. 83.

BLANCHE PARRY, D. 1589.

THOMAS OWEN, D. 1598.

FIG. 85

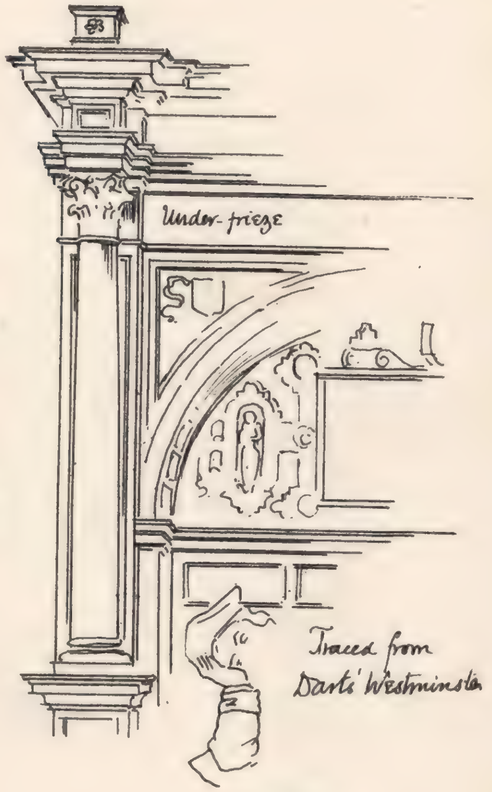


FIG. 84.

FIG. 88.

ISAAC CASAUBON, D. 1614.

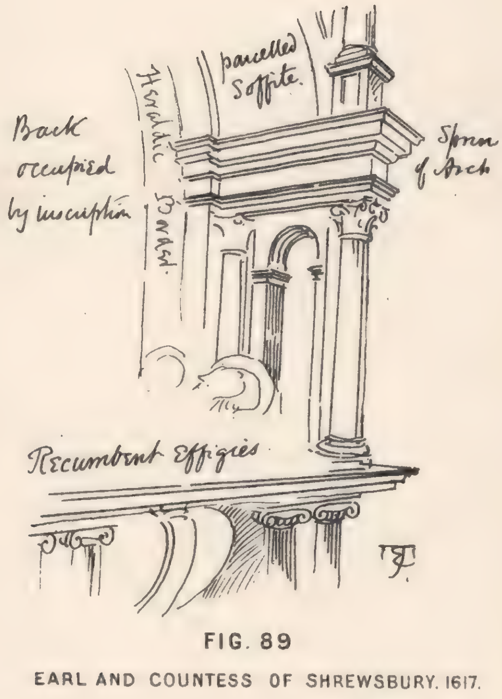


FIG. 89

EARL AND COUNTESS OF SHREWSBURY. 1617.

C.F. Kell, Photo-Litho. Castle St Holborn, London, E.C.

IV. ENGLISH MONUMENTS OF THE SIXTEENTH AND SEVENTEENTH CENTURIES. (XXI).

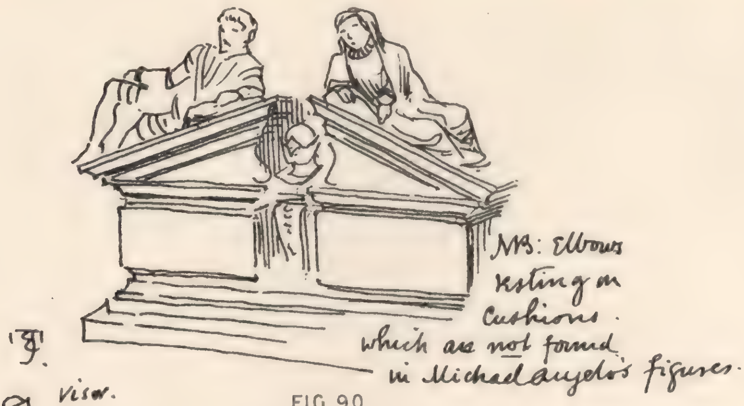


FIG. 90.

SIR CHRISTOPHER HATTON & HIS LADY, 1619.

FIG. 91.

SIR G. HOLLES. 1626.

FIG. 92.

M. DRAITON, 1631

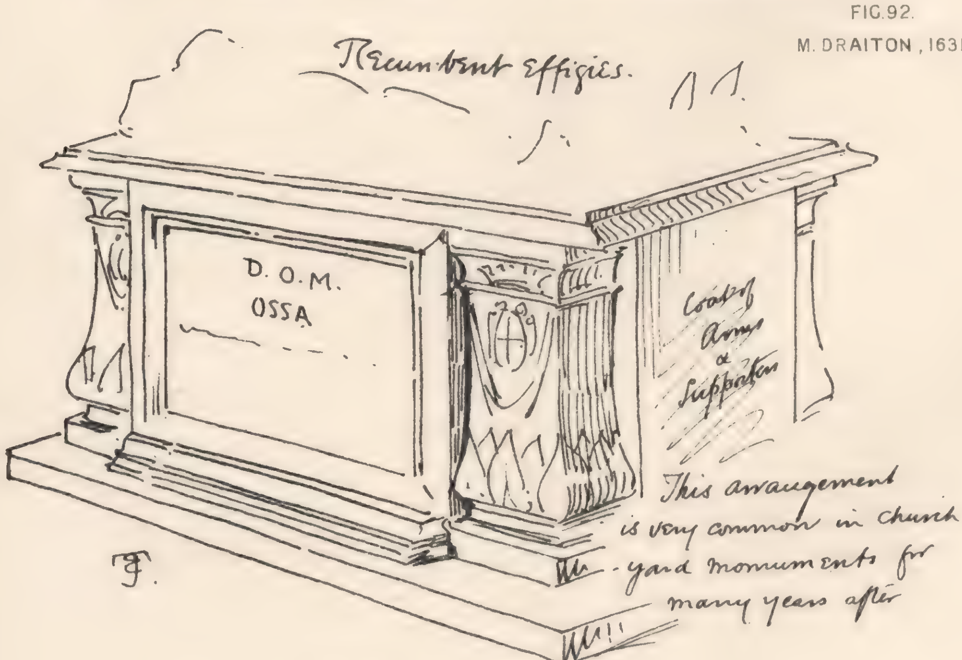
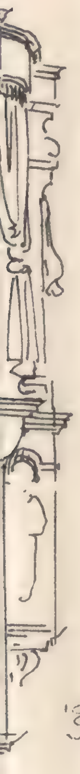


FIG. 93.

SIR GEORGE VILLIERS & COUNTESS OF BUCKINGHAM, 1605.

FIG. 94.

FRANCIS EGIOCKE,



D. 1622.

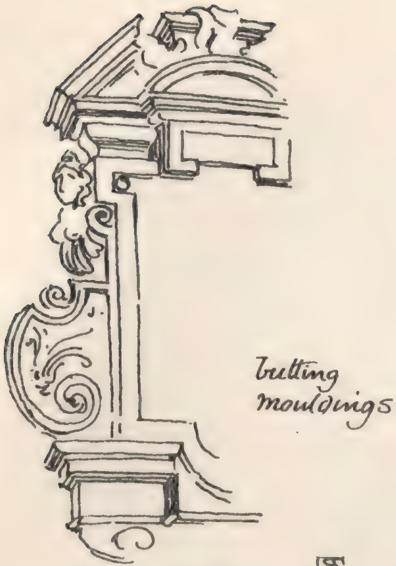


FIG. 95.
E. REYNOLDS, D. 1625.

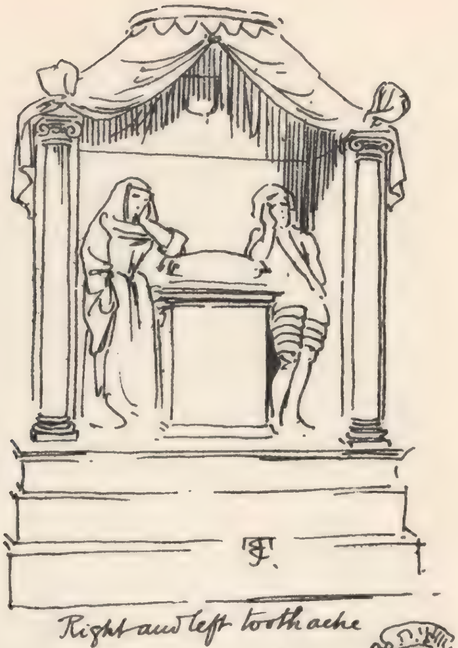


FIG. 96.
COL: POPHAM AND HIS LADY, 1651.

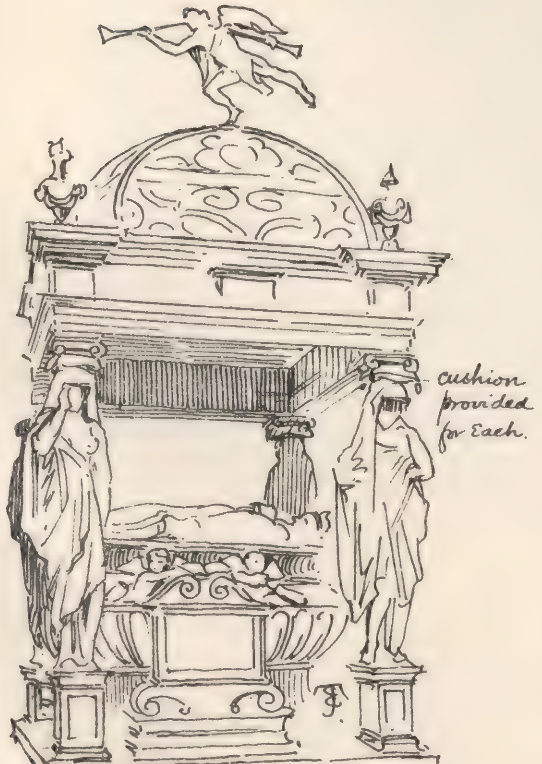


FIG. 97.
DUKE & DUCHESS OF RICHMOND, 1639.

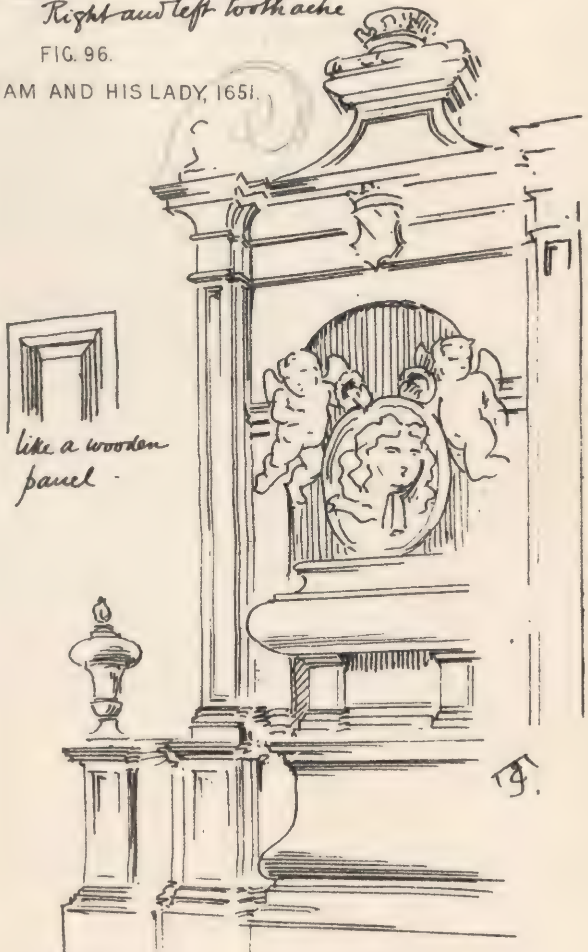
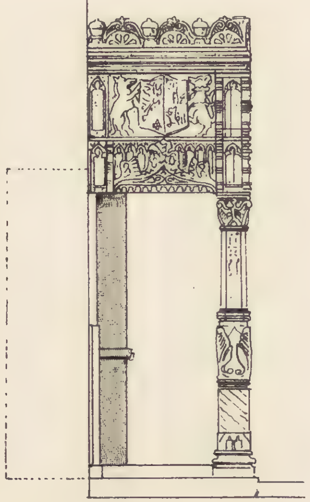


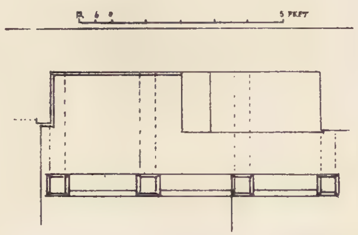
FIG. 98.
SIR GEORGE SAVILLE, 1695.

C. F. Kell, Photo-Litho. Castle S^t Holborn, London, E.C.

IV. ENGLISH MONUMENTS OF THE SIXTEENTH AND SEVENTEENTH CENTURIES. (XXII)

SECTION, FIG. 101.





PLAN, FIG 100.

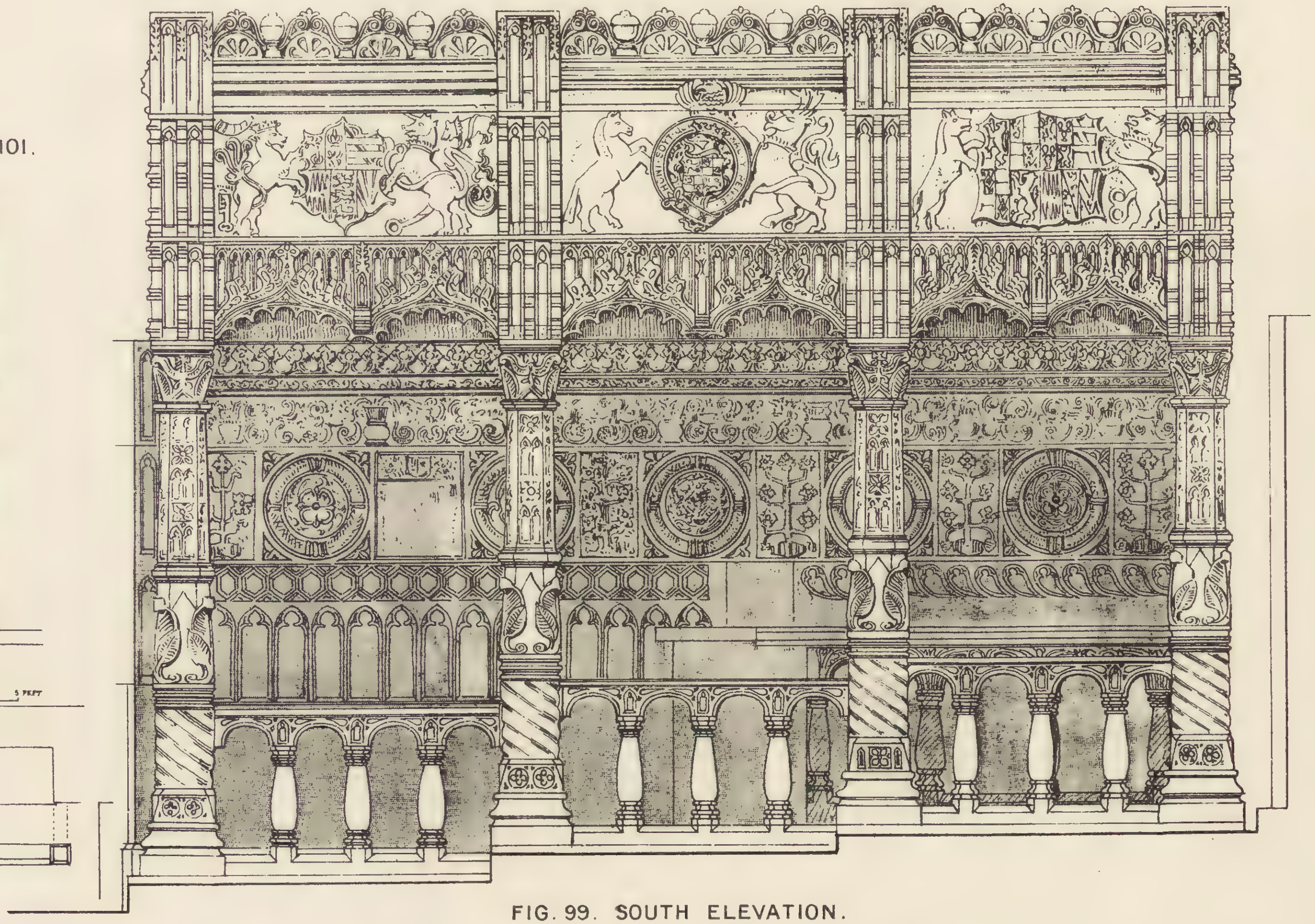


FIG. 99. SOUTH ELEVATION.

MONUMENTAL TOMB IN THE FITZALAN CHAPEL, ARUNDEL CHURCH, SUSSEX.

W. S. Weatherley, del.

C.F. Kell, Photo-Litho. Castle, St Holborn, London, E.C.

IV. ENGLISH MONUMENTS OF THE SIXTEENTH AND SEVENTEENTH CENTURIES. (xxiii).

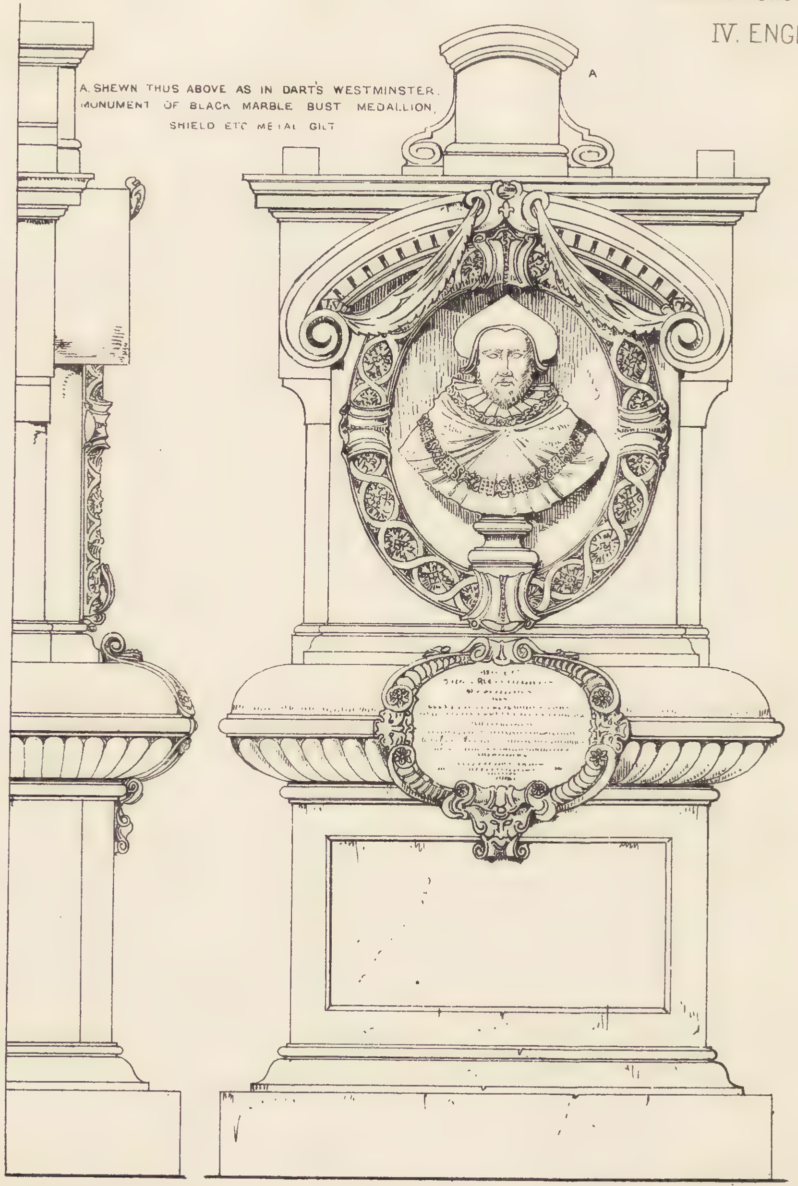


FIG. 103. FIG. 102.

MONUMENT TO SIR THOMAS RICHARDSON, IN WESTMINSTER ABBEY.

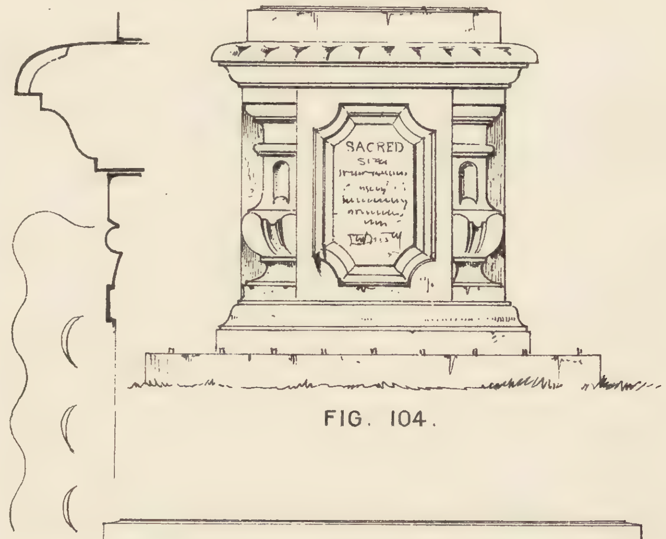


FIG. 104.

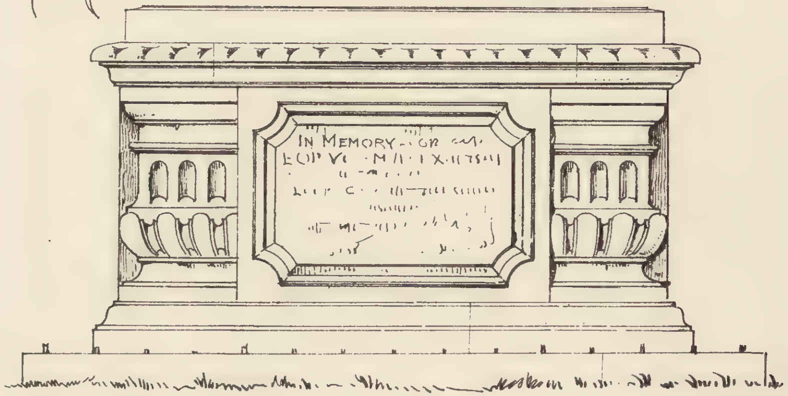


FIG. 105.

CHURCHYARD TOMB, ST JAMES'S CLERKENWELL.

W. S. Weatherley, del

C. F. Kell, Photo-Litho. Castle St Holborn, London, E.C.

V. THE ACTION OF LIGHTNING STROKES IN REGARD TO THE METALS AND CHIMNEYS OF BUILDINGS.

By Colonel the Hon. ARTHUR PARNELL,* late R.E.

[Read on Monday, 21st January 1884, Ewan Christian, *Vice-President*, in the Chair.]

THE present Paper is one of the results of a research into the nature of the action of lightning-strokes made by me during the last four years; and I trust that even if architects should be unable to agree with the conclusions I have arrived at, they will at all events, be in a position to make their own inferences from the details now submitted. The incidents (505 in number) are collected from a compilation of cases of lightning-strokes (amounting up to date to 1145), that have occurred between January 24th 1665, and November 23rd 1883; and they embrace only those building constructions at which *metals* or *chimneys* are described as having been present in the immediate vicinity of the scene of the stroke. In addition to the 505 incidents referred to in the present Paper, I have compiled 189 cases in which the presence of metals or chimneys is not mentioned. Thus the total number of cases of buildings struck that have been collected is 694, and the proportion of cases at which metals or chimneys were connected with the action of the stroke is 70 per cent.

The fact that churches are frequently struck is important. Nearly all those mentioned had spires, towers, or other tall features, and elevation is one of the circumstances that, according to experience, presents—*ceteris paribus*—facilities for the origination of lightning-strokes. But the list will fully demonstrate how completely most of these high objects were permeated by metal in one form or another, and it can hardly be doubted that these metallic objects were the principal causes of the disasters. In regard to cottages and farm houses, probably the great majority of accidents that occur to them are not recorded either in newspapers or other publications. Official statistics, however, relative to the deaths caused in various countries by lightning-strokes, furnish strong presumptive evidence that the buildings which, throughout the world, stand most in need of treatment in respect of defence from lightning-strokes, are the cottages of the agricultural classes. In connection with the 12 powder magazines recorded as struck, it is noteworthy that 11 of them (91 per cent.) were defended by lightning-rods. No less than 184 separate cases of buildings fitted with these instruments are included in the list. In 40 per cent. of these cases the buildings thus fitted were seriously damaged; and in connection with the question of the value of lightning-rods all these cases deserve close study. If among the number there should be one incident more noticeable than the rest, it is, perhaps, No. 1029. This is the record of the explosion of a small powder store, 11 feet 6 inches long, by 7 feet 6 inches broad,

* Author of the *Action of Lightning and the Means of Defending Life and Property from its Effects.* 8o Lond. 1882.

by 7 feet 6 inches high, external dimensions. To this building was attached at one end a copper lightning-rod no less than 20 feet 6 inches high, properly connected to the earth. In the same neighbourhood, and during the same storm, this diminutive store alone appears to have been struck.

It is submitted that all the metal cases tell their own tale—the same unvarying story—that the presence of metal in any shape, form or position, does, in its measure, *tend* to attract lightning-strokes. To the writer there seems to be no room for any preconceived theory in the matter. Nature appears to supply us with facts ever-fresh, crushing, and palpable. The proportion of chimney cases to the whole number of building incidents is 19 per cent. It will be borne in mind that, in the shape of grates at different levels, the chimney breasts themselves usually contain the principal masses of metal within a dwelling-house. Probably the principal dangers inherent in the chimneys of houses are three in number, viz.:—(1) The metal grates, ranges or boilers; (2) The more or less vertical column of soot from the ground to the highest point of the house; (3) The prominent stacks and pots by which the flues are surrounded. In boiler chimneys there is not only a greater mass of metal at the bottom, but the height of the column of soot is greatly raised, and the stalk itself is a most prominent object.

The physical effects of lightning-strokes are principally of two kinds, viz. :—(1) Mechanical work; (2) Heat work. And here it may be mentioned, that one of the principal points that strikes the attention of the student of terrestrial physics, is the abundant evidence that meets him in regard to the mechanical work of lightning-strokes. In fact, their main element appears to be ordinary mechanical force. In the present list the number of separate incidents in which traces of mechanical force are recorded is more than double that of those in which traces of heat are mentioned, and an analysis of the cases I have compiled affords no less than 828 separate instances of mechanical force exercised on various substances, as against only 228 of heat. Of these 828 mechanical cases the majority are in connection with materials easily inflammable or fusible. Most persons would doubtless imagine that dry woodwork was more likely to be charred or burnt by what is called "lightning," than to be forcibly rent without a mark of scorching; but the reverse is the case. Also in respect of metals, few would believe that this agency was more apt to break or bend metals than to fuse them; but this certainly is the fact. Out of the 505 incidents, 399 supply instances of mechanical work, and only 183 of heat work. In regard to the direction of the action of the mechanical force, in 34 per cent. of the incidents evidence is furnished of a more or less upward direction, in 66 per cent. there is no record of the direction, and no single case contains proof of a downward direction.

RECORDS OF CASES OF LIGHTNING STROKES.

The following list gives, in a condensed form, details of 422 out of the 505 cases collected, space not being available for the remaining 83 cases. The numbers preceding the incidents refer to my complete list of recorded instances. The lightning-rod cases are Nos. 18, 64, 86, 87, 94, 96, 105, 106, 107, 109, 110, 111, 112, 114, 117, 120, 121, 122, 124 to 132, 135,

136, 142, 170 to 173, 180, 181, 190 to 193, 294, 310, 321 to 323, 329, 333, 341, 346, 387, 388, 446, 469, 472, 473, 475, 477, 478, 488, 499, 501, 503, 506, 512, 533, 549, 559, 565, 567, 575, 588 to 680, 794, 906, 908, 919 to 922, 939, 943 to 947, 949, 955 to 959, 964, 966, 973, 986, 989, 992, 1003, 1008, 1014 to 1031, 1034, 1045 to 1053, 1055 to 1058, 1060, 1079, 1116 to 1143. The 422 incidents are,—

(1) HANLEY. June 6th, 1881. Candle factory. EFFECTS.—*Boiler chimney*, 60 feet high, thrown down and building wrecked. [W.M.N., 11/6/81.]

(6) DARWEN, LANCASHIRE. July 5th, 1881. Two-Gates mill. EFFECTS.—*Boiler chimney* thrown down. [Stand., 7/7/81.]

(18) OLDHAM. May 22nd, 1881. Messrs. Radcliffe's mill. *Boiler chimney* with *lightning-rod*. EFFECTS.—Four large coping stones dislodged, crushing in roof and flooring of stables beneath. Lightning-rod "wrenched off." [Tel. Journ. 1/6/81.]

(19) CARYSFORT REEF LIGHTHOUSE, NEAR KEY LARGO, FLORIDA, U.S.A. April 12th, 1877. Built on a submerged reef. Consisted of a framing of stout *iron pillars*, 100 feet long. At 40 feet above sea level was keeper's room, with roof and sides formed of *iron plates*, and wooden floor. EFFECTS.—Struck 17 times. No injuries recorded. [Spang. 39.]

(23) CAPE OF GOOD HOPE. June, 1881. Stables of Cape Mounted Rifles. *Iron roof* and *mangers*. EFFECTS.—Nineteen horses thrown down, one killed and six blinded. Two men standing in doorway struck down. [Elect. 9/7/81.]

(25) CHRIST CHURCH, BRADFORD. July 5th, 1881. EFFECTS.—*Belfry* "destroyed." [Elect. 9/7/81.]

(28) BARROW-IN-FURNESS. July 5th, 1881. Corner house. Had a *rainwater down pipe* running into the ground. EFFECTS.—Slates stripped from gutter to ridge above down pipe, brick *chimney* 4 feet above ridge "pierced," bricks scattered over roof. [Elect. 16/7/81.]

(29) BARROW-IN-FURNESS. July 5th, 1881. Private house with a *lightning-rod*. EFFECTS.—Rod seen to be repeatedly struck. Top showed marks plainly. [Elect. 16/7/81.]

(32) ALNWICK. August, 1881. Tannery. EFFECTS.—*Boiler chimney* partly demolished. [Elect. 27/8/81.]

(33) CREMONA. August, 1877. Church of the Holy Sepulchre. High tower with *weathercock* of tinned copper, surmounted by *iron cross*. Iron rod of weathercock ·47 inch thick passed through a marble slab. EFFECTS.—Slab shivered. Weathercock perforated with 18 holes and thrown 20 feet from the tower. Rod broken, but not fused. [Arago, 74 and 84.]

(34) GREAT MARTON, LANCASHIRE. April 21st, 1807. Windmill. EFFECTS.—Boards of lower floor "torn up." Large *iron chain* hanging over the floor was welded into a solid rod. Three sails shivered to pieces. [Howard II. 34 ; Arago, 73.]

(39) VICENZA. June 25th, 1827. A house with rain *waterpipe* and *tin eaves-gutter*. EFFECTS.—Three holes pierced in rain-pipe. Eaves-gutter received a rent 4 or 5 inches long. [Arago, 85.]

(43) SWINTON, ECCLES, NEAR MANCHESTER. August 6th, 1809. House of Mr. Chadwick. Alongside house was a brick built coal shed, with water *cistern* above. Foundation and bottom of shed about one foot below ground level. Walls 3 feet thick, and strengthened by bond timbers. Top, bottom, and sides of cistern covered by large flags. EFFECTS.—Outside wall of shed removed from upright position, one end being distant 9 feet and the other 4 feet from its original position, the copings remaining entire. The bond timbers were forced to a somewhat greater distance than the brickwork, and seemed scorched. The weight of material displaced was about 26 tons. Adjacent to the place were some slender metal "*spout* "*brackets*," also a leaden *water pipe*. These were uninjured. [Proc. L. & P. Soc., Manch., 2nd series, II. 259.]

(64) CHESTER, U.S.A. (No date given.) House of Mr. Thomas Lieper, near this town. Had two *lightning-rods* and several rain water *down pipes*. Was almost surrounded by water. An avenue of oak trees on rising ground, distant 60 feet. EFFECTS.—House struck. Trees untouched. [Arago, 211.]

(67) STRACHETTA, NEAR BRESCIA. August 29th, 1881. Parish church. *Clock* tower with *iron cross*. Struck during service. EFFECTS.—Many persons thrown down and one killed. Hands of clock torn off. [Elect. 10/9/81.]

(72) CANNES. Sept. 1881. Holy Trinity church. EFFECTS.—Arch containing *bell*, and a large stone cross, "destroyed." [Elect. 24/9/81.]

(78) GRAFTON, OHIO, U.S.A. July 31st, 1881. A private house. EFFECTS.—Girl playing in a lower room killed. Roof pierced near one of the *chimneys*. [Elect. 15/10/81.]

(79) SAUGUS, ESSEX, Co. MASS., U.S.A. July 21st, 1881. Telegraph office. EFFECTS. — Carpet burnt, "torn up" and blackened. *Pen* and penholder in hand of a lady sitting two feet from *instrument* table copying a message melted, and paper scorched. Connections of instrument "burnt off." One of *wires* "destroyed." Lady unhurt, except for a slight pain in side nearest instruments. [Elect. 15/10/81.]

(80) WAUNAKEE, WIS., U.S.A. July 20th, 1881. A private house. EFFECTS.—Every "*wire screen*" door in building "demolished." Occupants unhurt. A rent about 26 feet long torn through roof, and *chimney* struck. [Elect. 15/10/81.]

(82) CHICAGO, ILL., U.S.A. July 20th, 1881. A private house. EFFECTS.—*Stove* cracked ; windows "demolished." One person killed and two others knocked down. Shingles on side of house torn off. *Chimney* knocked to pieces. [Elect. 15/10/81.]

(83) DELAWARE, OHIO, U.S.A. July 22nd, 1881. A private house. EFFECTS.—Large hole made in floor of a lower room, and a cooking *stove* therein broken to pieces. In an adjoining room a bed torn to shreds. Several floor joists of room above splintered. *Chimney* struck. [Elect. 15/10/81.]

(84) MOUNT WASHINGTON, U.S.A. July 16th, 1881. A printing office, on summit. EFFECTS.—A case of *type* scattered. [Elect. 15/10/81.]

(85) CHATEAU NEUF - LES - MOUSTIERS, (BASSES - ALPES), FRANCE. July 11th, 1819. Parish church. Struck during Mass. EFFECTS.—(1) In a stable below church a hole was made under the foundation, and five sheep and a horse were killed. Another hole, ½ m. (1 ft. 7½ in.) in diameter, was made under the foundations of the church walls and the adjacent street pavement. (2) The pulpit was broken and the missal torn from the hands of the man who was chanting. All the people in the church were thrown down; nine were killed and eighty-two injured. One of the curé's shoes was carried away to the other end of the church, and one of the metal *buckles* was broken. The gold on his *stole* was marked. He had five scars on his body. The celebrating priest in a silk vesture was not in any way affected. (3) The vaulted roof was pierced at a point about ½ m. (1 ft. 7½ in.) from where the *bell* rope passed. The *cross* of the *bell* tower was thrown to a distance of 16 m. (52 ft.). [Pouillet, II. 77.)

(86) WALTHAM ABBEY, ESSEX. Summer, 1878. Government powder factory. Range of new incorporating mills. Centre building 50 feet high, with two wings of lower buildings 60 or 70 feet long. A copper *lightning-rod* over centre building and one at extreme end of each wing. EFFECTS.—One of these latter rods was struck. Parts of the *iron roof trusses* to which it was connected were loosened, and all the mortar shaken out of some of the joints of the brick and iron work. The high part of building was not struck. [Major Tovey, R.E., R. U. S. I. Journ., CXII. 1881, and letter.]

(87) WALTHAM ABBEY, ESSEX. Summer, 1879. Government powder factory. A small low building (apparently wooden), with a copper *lightning-rod* leading directly into water and well immersed. Building was close to a large stream, within 220 feet of a chimney 150 feet high, and surrounded by trees. EFFECTS.—Rod struck, in places separated from the wood work, and large *copper basin* full of water balanced over a mill was shaken down. [Major Tovey, R.E., R. U. S. I. Journ., CXII. 1881, and letter.]

(88) WALTHAM ABBEY, ESSEX. 1880. Government powder factory. A *bell wire* was attached to a tree, and also fixed to some wooden posts by *copper nails*. EFFECTS.—The wood between the nails on one of the posts was torn out, and the tree was struck. [Major Tovey, R.E., R.U.S.I. Journ., CXII., 1881, and letter.]

(89) ENFIELD LOCK, NEAR WALTHAM ABBEY. 1880. Private house. EFFECTS. — The *iron grates* on three floors were shaken out of place, and in one of them the grate was thrown into the middle of the room. The *chimney* was struck. [Major Tovey, R.E., R.U.S.I. Journ., CXII., 1881, and letter.]

(91) ORKNEY ISLANDS. Jan. 5th, 1882. A farm house. EFFECTS.—Four persons sitting round fire injured. *Chimney* struck. (pres. damaged.) [Elect. 14/1/82.]

(92) WEEK ST. MARY, CORNWALL. Nov. 8th, 1878. Parish church. Tower with lofty pinnacles; slate roofs. Some of pinnacle stones bound by *iron cramps*. Masonry tower faced with granite. Walls about 4 feet thick. A horizontal *iron bar* across belfry window, and another at bottom of it. At S.E. angle of tower a *leaden rainwater pipe* ran down wall, but stopped 12 feet short of the ground. EFFECTS.—(1) A large granite block a few feet above this pipe was broken in two, and portions separated half an inch. Stonework below lower bar of belfry window "much knocked about." Just above this window a granite block, 2 feet by 14 inches on face, was forced out about 10 inches beyond face of wall. (2) Whole S.W. pinnacle shattered, the stones being forced out from 1 to 5 inches around axis of pinnacle, and one block 2 feet long being thrown right out beyond tower walls. The two uppermost stones, a truncated cone, and a cross (both of granite) were unaffected. [L.R.C., 30. Rev. G. H. Hopkins (rector), and Mr. J. P. St. Aubyn, F.R.I.B.A.]

NOTE.—Tower had been struck in 1688, 1812 and 1843.

(93) ST. ANN'S HOTEL, BUXTON. 1875. EFFECTS.—Mantelpiece in drawing-room displaced. Many panes of glass broken. *Chimney stack* shattered. [L.R.C., 34. Mr. D. Brandon, F.R.I.B.A.]

(94) TWYFORD MOORS, NEAR WINCHESTER. June, 1878. A private house. Tower with pyramidal roof and copper *lightning-rod* passing down through glass insulators, as far as a *lead flashing* half way down tower. Thence rod proceeded inside a *rainwater pipe* into a cesspit. EFFECTS.—Building damaged at a point half way up a gable end, 64 feet distant from the rod and 16 feet below its summit, and a little above an *iron gutter* and a *rainwater down pipe*. Slight damage effected, tiles and laths being knocked off. No signs of scorching. [L.R.C., 34. Mr. J. Colson, F.R.I.B.A.]

(95) ST. JAMES'S CHURCH, WEST END, HANTS. June 12th, 1875. With brick tower and spire, ridge covered with lead; *iron* and *lead gutters*, *iron rainwater pipes*, and two *iron chimneys*. Stone angles fixed by *iron cramps*. Spire surmounted by an *iron spindle*. Many trees near. EFFECTS.—The spire received a great rent on one side and had to be pulled down. Stones from it were thrown through some trees 126 feet distant. [L.R.C., 34. Mr. J. Colson, F.R.I.B.A.]

(96) FOSSNES CHURCH, NORWAY. About 1871. Built of wood, with a *zinc lightning-rod*. EFFECTS.—Rod melted. [L.R.C., 107. H. Mohn (of Kristiania).]

(97) LEWISHAM. 1872. Private house. At one end a *rainwater pipe* entering earth. EFFECTS.—Pipe struck. Window near its summit pierced. An adjacent *gas pipe* struck, and gaselier to which connected in a room near other end of house broken to pieces. A contiguous *chimney* at this end of the house surmounted by a *zinc top* was struck. [L.R.C., 37. Professor T. Hayter Lewis, F.S.A., F.R.I.B.A.]

(98) WANDSWORTH. 1875. Private house. An *iron rainwater down pipe*, an *eaves-gutter*, and a *chimney stack* at one end of house. EFFECTS.—Chimney stack damaged. [L.R.C., 38. Professor T. Hayter Lewis, F.S.A., F.R.I.B.A.]

(100) GRAVESEND BARRACKS. 1873. Laundry *chimney* shaft, 40 feet high. *Iron eaves-gutter* surrounded building and shaft, and was connected to two *rainwater down pipes* at opposite corners respectively. EFFECTS.—The chimney shaft above the eaves gutter was entirely destroyed. "The disruptive "force was so great that the bricks were scattered over "a radius of 200 feet, and the slate roof was riddled "like a colander by the brickbats." [L.R.C., 40. Colonel the Hon. G. Wrottesley, R.E.]

(101) WALTHAMSTOW CHURCH. June 5th, 1858. Effects.—Robing room and various parts of the exterior injured, *gas pipes* "torn open," *gutters* "torn up," and flagstaffs shivered. [L.R.C., 44. Mr. G. J. Symons, F.R.S.]

(102) ST. MICHAEL'S CHURCH, STAMFORD. August 14th, 1857. Modern structure, in centre of town. Tower with pinnacles. At base of S.E. pinnacle is a 3-inch *iron rainwater down pipe* entering the earth. Effects.—S.E. pinnacle shattered. The effect of the discharge "was to uplift the whole mass, "imparting to it at the same time a kind of circular "motion to the southward, the apex of the pinnacle "falling in a line with its original base; and the base "having traversed about the eighth part of the circle, "fell into the roof of the tower." The pinnacle was a mass of masonry bound by *iron clamps*, and weighing about 15 cwt. At every break in the arrangement of the clamps large masses of stone work were driven out, the stroke "spreading them over "the roof of the nave and churchyard, doing con- "siderable damage to the roofing and tombstones." [L.R.C., 43. Mr. G. J. Symons, F.R.S.]

(103) RUBISLAW, BLEACHFIELD, NEAR ABERDEEN. June 26th, 1859. *Boiler chimney;* height 240 feet. Effects.—At a height of 120 to 160 feet three patches of surface bricks were torn off. The two largest were 7 feet by 3 feet and 4½ feet by 3 feet, the longest dimensions being vertical. The depth or thickness of patches was 4½ inches. Stability of chimney not affected. The four patches extend upward in an irregular line in a spiral of about one-third round the circumference of the chimney. [L.R.C., 45. Mr. Alex. Cruickshank.]

(104) DRIFFIELD, YORKSHIRE. July 19th, 1859. Manure works. *Boiler chimney*, 85 feet high; upper portion of stone, resting on octagonal brick shaft with a stone base. *Hoop iron* was imbedded in every fifth or sixth course of brickwork. A building at foot of chimney with a *ventilator* under its roof. A large warehouse adjacent. Effects.—(1) Chimney split between ventilator and a point 10 feet below. At ventilator 7 feet of solid brickwork intervening between it and stone base was pierced. (2) The stone base was displaced, and above it the shaft was split asunder in a straight line for a height of 15 feet, and remaining portion was shattered in all directions on three sides, portions of brickwork several feet in length being completely detached both inside and outside. (3) The lowest two-thirds of the stone shaft was displaced, and the upper third was detached and thrown down. [L.R.C., 46. Mr. John Sterriker.]

(105) CHURCH OF STE. CLOTILDE, PARIS. 1863 (first time). Had *two iron lightning-rods*, with five upper terminals. Rods went round the building and led through insulators into two walled wells of water. Building has *iron roofs*. Effects.—The rod on the transept was struck, and the *platinum* tip of the copper point carried away. [L.R.C., 69. M. Francisque. Michel.]

(106) CHURCH OF ST. ELOI, PARIS. Sept., 1874. An *iron lightning-rod* on spire. Joints in bad condition, and needed soldering. Underground part much rusted. Soil dry and calcareous. Effects.—Rod twisted, terminal broken, and part above *cross* thrown down. Spire damaged and cracks made in apse. [L.R.C., 69. M. Francisque Michel.]

(107) GARDING, SCHLESWIG-HOLSTEIN. May 18th, 1877. Church with steeple. Large number of *tie rods* in steeple. Copper rope *lightning-rod* on steeple, leading into a well. Rod had a conical point, rather blunt, with a *platinum* tip. Effects.—Rod fractured in fifteen places, and steeple pierced in two places. [L.R.C., 115. G. Karsten (of Kiel).]

(108) ANTWERP RAILWAY TERMINUS. July 10th, 1865. With a *glass roof.** The only effect was the perforation of a single hole in one of the glass squares of the roof about 4 mm. thick. "It ap- "peared as if it had been traversed by a projectile "from below, the perforation, viewed from above, "being broken and chipped, whilst viewed from "below it showed a clean edge." [L.R.C., 137. M. Melsens, Member of Roy. Acad. of Belgium.]

* Such a roof would necessarily have a framework of iron.

(109) CHURCH OF ST. CROIX, IXELLES, BELGIUM. July 3rd, 1874. On steeple at one end of church was an *iron lightning-rod*, 174 feet above pavement, which passed along roof ridges and descended into a well (with abundance of water in it) near the far end of church. A second terminal, 17 feet 3 inches high, projected from rod above ridge near transept. There was a third terminal on a small dome over far end of chancel roof. Effects.—Point struck was a stone cross on transept roof, distant 36 feet and 72 feet respectively from the second and third terminal. Church slightly damaged. [L.R.C., 140. M. Melsens, M.R.A. of Belgium.]

(110) NASH LOW LIGHTHOUSE. Aug. 31st, 1852. *Lightning-rod* (presumably of copper) was fastened to metal of *lantern*, and descended *inside* lighthouse tower to level of ground, where it emerged through wall underneath the flag pavement surrounding the tower. A water butt in gallery outside lantern, with *copper down pipe* to a drain. This pipe had three joints, put together with tow and *white lead.* Kitchen floor of stone, joints filled in with *pieces of lead*, and below was oil cellar (with *cans*). Effects.—(1) Traces of stroke on inside of oil cellar walls, close above oil cans. A piece of lead in kitchen floor was "thrown out" at a distance of about 9 inches from rod. Here also skirting of kitchen wall was "thrown "off," a chair broken, and the *fender* "upset." (2) On different parts of the exterior of tower near ground portions of cement were thrown off. Where copper pipe ends at drain the discharge had "blown up" a little of the cement, and the cement was also broken up at the point where the rod entered the pavement. (3) Inside lantern there were traces of the stroke, where metals were near together but not actually touching. Some signs of oxidation were seen on the rod at a rivetted joint. Some cement was thrown off near the tub of water outside the lantern. Keeper thrown down. Flagstaff struck. The copper pipe leading to the ground was pierced with a hole at each of the three joints in its length. [L.R.C., 187. Professor M. Faraday, F.R.S., Sept. 27th, 1852, after inspection.]

Note.—The rod appears to have had no pointed upper terminal. The stroke was probably a multiple one.

(111) EDDYSTONE LIGHTHOUSE. Jan. 11th, 1853. Height, 107 feet from low water mark to top of vane. In the body of stonework were *eight rings of metal*, each going round the tower, and consisting of

a bar of solid iron and lead 4 inches square. The bed room and sitting room were lined with a *framework of iron bars* connected to a copper lightning-rod, which descended from the floor inside the tower and ended outside on the rock between high and low water marks. The stroke occurred when the end was 6 feet from the water, if the latter were quiescent. EFFECTS. —"A partial flash discharge" occurred in the living rooms. No damage was recorded. [L.R.C., 189. Professor M. Faraday, F.R.S., Jan. 24th, 1853, after inspection.]

NOTE.—The rod appears to have had no pointed upper terminal.

(112) SUNDERLAND. Nov. 13th, 1878. *Boiler chimney* of a colliery. Height 180 feet. *Lightning-rod* of copper. First holdfast of rod was driven tightly into a wooden plug let into wall, pinning rod closely thereto. The earth connection was good. EFFECTS.—The upper terminal was broken off and found lying on the chimney, quite brittle, and easily broken by hand. A length of 10 feet of the rod below extending to the first holdfast, was in the same state. Many bricks were displaced at top of shaft. [L.R.C., 193.]

(113) HALL-HILL FARMHOUSE, NEAR MONIEMAIL, CUPAR. EFFECTS.—(1) All along course of discharge and particularly near *bell-wires* small holes about 1 inch deep were made in walls. Two parallel vertical bell-wires were partially fused and flattened together. (2) House shattered from bottom to top. Window-blind of staircase, down at the time, was riddled as if with small shot. Most of the windows shattered. All the fragments of glass were on the outside. Two servants injured. (3) *Lead ridge* of roof struck and roof pierced. A large stone thrown out from one of the *chimneys*. [Sir William Thomson, F.R.S., Papers on Elect. and Magn., 1872.]

(114) ST. GILES' CHURCH, CRIPPLEGATE, LONDON. About 1877. At corner of tower was a flagstaff with a *lead cap*. A *copper lightning-rod* stood over centre of tower and passed down in the form of a wire rope some distance into the earth. The summit of rod was considerably lower than top of flagstaff. EFFECTS. — The portion of flagstaff above level of rod was shattered to splinters. Rod uninjured. [L.R.C., 196. Mr. Richard Herring (who witnessed stroke).]

(115) TROLLEY BOTTOM, FLAMSTEAD, HERTS. August 6th, 1879. The "Wheatsheaf" public-house, with two storeys. EFFECTS.—(1) On ground floor in tap room, in front of house, a small round hole pierced in window pane, and a woman sitting there killed. In adjacent front parlour, on same floor, window frame was wrenched outwards two or three inches, several panes broken, and window frame and lining scorched near *iron sash weights*. Wooden *chimney* piece slightly moved, and "a bottle of ink which stood there was thrown with "some violence to the ceiling." Gable wall containing this chimney shattered. Close to the wall a stout post supporting roof of a lean-to was split and wrenched from its position. (2) Front windows in first floor, above those in tap room and parlour, were also wrenched and scorched like parlour window. [L.R.C., 198. Mr. J. E. Groome (landlord of "Wheatsheaf").]

(116) CANNES, FRANCE. About 1874. A villa. High position; but another much higher villa within 100 yards, and on higher ground, untouched. EFFECTS. —(1) The discharge struck an under-ground drain, "which it burst up, hurling into the air the trees "planted above it." Also a well "the door of which "(*locked* the night before) was burst open." The soldering of the joints of three *rainwater down pipes* which entered the ground was melted. (2) In a certain room the front of the *grate*, together with the *fire irons*, "were all projected across the room, about 30 feet." Above this grate the brick *chimney* stack, which had a *metal cowl*, was blown up, "together with much of the roof and wall of the house "(great portions of the solid masonry of which I found "50 or 60 yards off!") (3) A level asphalte roof was melted, "in spite of the water lying on it." [L.R.C., 198. Mr. H. Radcliffe Dugmore (of The Lodge, Parkstone, Dorset), who was in the house at the time.]

(117) MIDDLESBOROUGH FEVER HOSPITAL. Oct. 11th, 1878. *Chimney* stalk of washhouse; height 50 feet, with a *copper lightning-rod*. Close to base of chimney was a *boiler* and an *iron disinfecting apparatus*, from which an *iron flue* led into the chimney shaft at a height of 9 feet from the ground. EFFECTS. —Near this point a fracture was made in the brick work of the chimney, the stone work at top of boiler was broken, and "other damage done." [L.R.C., 204. Mr. E. D. Latham, C.E., Borough Surveyor.]

(119) PEDDA KONDUR, MADRAS PRESIDENCY. May 8th, 1878. A small domed pagoda or temple on west bank of river Kristna, 32 feet high to apex, on which was a *copper finial*, 1 foot high. Thickness of dome at crown, 2 feet 6 inches. Inside was the idol, a cylindrical stone pillar standing on a square hollow stone tray. Building of brick and mortar, unplastered. Within 50 yards were two trees exceeding it in height. Wind from east. EFFECTS.—(1) Small hole bored in tray below idol on east side, at the joint of a stone. (2) Masonry at apex of dome cracked in three places, and a small hole bored in it of same size as that in stone tray. Masonry round base of copper finial shattered. "A shower of pieces "of brick and mortar sent from top of pyramid and "scattered over ground on east side to a distance of "about 20 feet from base." [L.R.C., 207. Lt.-Colonel Asted, R.E. (eye-witness).]

(120) BEREHAVEN LIGHTHOUSE. February 1877. A copper *lightning-rod*, 10 feet high above the gutter outside *lantern*, was secured to dome at a collar 5 feet above gutter by three *iron stays*, and passing through gutter proceeded down outside lantern (close to glass) to the stone balcony floor. Through this it passed down face of lighthouse (to which it was fastened by *iron holdfasts* and *copper bands*) to the rock at base. EFFECTS.—(1) On S.E. side lighthouse wall pierced at base near the rod in several places, the discharge also "rooting up the solid rock." (2) The wall at principal keeper's bedroom pierced at an *iron holdfast* of a *leaden speaking tube*, the cut stone kneeler and barge course being burst out. In this room the stroke "burst out the studding and lath and plaster, "tearing away the speaking tube, the footboard of the "bed, and destroying the pictures on the walls." (3) In the light room above, "after bursting off the "several coats of paint at the heads of the bolts of the "iron stays of the rod, it put out the lights, breaking "the glasses and knocking down both keepers in-"sensible; it having twisted off the lead speaking tube "where it was secured to the side of the light room "by a holdfast bursting out the stone sheeting between

" the *iron pillars* supporting the marble top." (4) The *eaves-gutters* of the dwelling adjoining lighthouse were split through the centre from one corner of the house to the other. (5) The lighthouse *chimney* of assistant keeper's kitchen was shattered; in yard at base, a tank (below a rain water pipe), with some adjacent slating and brickwork was broken; and at the w.c. the stroke acted by " breaking up the flags and seat." (6) At the pantry and outhouses close to the lighthouse the discharge "tore up portions of the 3 inch York-"stone flagging of the floor and yard, dealing destruc-"tion to the shelving, doors, glass, &c." [L.R.C. 208. Mr. A. J. Bergim (of the Irish Lights Office, Dublin), after inspection.]

NOTE.—Doubtless the stroke was a multiple one.

(121) UPWOOD GORSE, CATERHAM, SURREY. May 28th, 1877. Residence of Mr. J. Tomes, F.R.S. House, highest object in the vicinity. Steep tiled roof. On ridge were two brick *chimney* stacks. On east stack was a *copper lightning-rod*, carried down side of house through glass insulators, and penetrating 12 inches into dry chalk. From a *flushing tank* in the yard a 1½ inch *iron pipe* passed to back of *sink* in scullery. EFFECTS.—(1) "The lightning broke the "slate at the back of the sink." (2) From a pump in scullery a 1½ inch *iron pipe* led to *two iron cisterns* inside roof near eaves. Here a hole was pierced through a 9 inch brick wall, and the edge of a *lead flashing* was fused. The red lead joints of adjacent *iron eaves-gutter* were broken. (3) Two holes were pierced in a window close to which the rod passed. The rod was broken at the connection of terminal with lower portion, the terminal was knocked down, and the adjacent chimney pots and brick-work were shattered. [L.R.C. 210. Mr. Rogers Field, M.I.C.E.]

(122) CHRIST CHURCH, CARMARTHEN. 1879. Had a square tower with slated roof, capped by an iron *ornamental ridging* with iron pinnacles at each end and in centre. A copper *lightning-rod* attached to iron ridging and projecting 18 inches above central pinnacle. A *gas pipe* passed about 1 foot underneath earth of rod. EFFECTS.—(1) At a point 4 feet distant from where rod entered ground the discharge "burst "out with explosive violence, blowing a circular hole "in the ground 2 feet in diameter and 8 inches deep." (2) At 3 feet from the foot of a *rainwater pipe*, 84 feet distant from rod, a second hole 9 inches deep and 1 foot in diameter was blown out. (3) A 2 foot length of *iron gutter*, 24 feet above the ground, was broken off nearly above the rainwater pipe already mentioned. (4) The central iron pinnacle was broken off and the top fused. [L.R.C. 217. Mr. J. Gavey (of Cardiff), after inspection.]

NOTE.—Doubtless the stroke was a multiple one.

(123) BOOTHAM BAR, YORK. June 22nd, 1876. A massive stone turretted archway with a flat *lead roof*. A range of houses a few feet distant from it. At a distance of 8 feet an ordinary street *gas lamp*, 11 feet 6 inches above pavement, was supported by an *iron bracket*. A vertical *iron gas pipe* proceeded from pavement to bracket. About 2 feet below bracket was the lead covering of a shop front. Bootham Bar was 33 feet above lamp, which was in a sort of cavity surrounded by higher objects. EFFECTS.—The lead over the shop front "was turned up off "the woodwork." About 18 inches of pipe was twisted and split open, and another 18 inches was melted. The gas was ignited at the top of the vertical iron pipe. [L.R.C. 219. Mr. J. E. Clark.]

(124) NICOLAI CHURCH, GRIEFSWALD, PRUSSIA. 1876. With tower. Had a *lightning-rod*; *gas pipes* had a few weeks before been placed in the tower, and were not connected to rod. EFFECTS.—Tower struck and set on fire. [L.R.C. 235. Professor Kirchoff, of Berlin.]

(125) NICOLAI CHURCH, STRALSUND. About 1876. (2nd time). Had a *lightning-rod; gas pipes* placed a short time before in the church, but not connected to rod. EFFECTS.—The rod was broken in many places. [L.R.C. 235. Professor Kirchoff.]

(126) SCHOOL HOUSE, ELMSHORN, PRUSSIA. 1876. Had a *lightning-rod*; adjacent *gas pipes* not connected thereto. EFFECTS. — Building damaged. [L.R.C. 235. Professor Kirchoff.]

(127) ST. LAWRENCE'S CHURCH, ITZEHOE, PRUSSIA. 1877. Had a *lightning-rod*; adjacent *gas pipes* not connected thereto. EFFECTS.—Building damaged. [L.R.C. 236. Professor Kirchoff.]

(128) COUNT VON SEEFELD'S CASTLE, PRUSSIA. May, 1809. Had a *lightning-rod.* There was a small *water pipe*, 80 metres (?), from rod. EFFECTS.—Discharge passed between rod and pipe, and burst the latter. [L.R.C. 236. Professor Kirchoff.]

(129) BASEL. July 9th, 1849. Private house. Had a *lightning-rod.* There was a C.I. *water pipe*, 1 mètre (3 feet 3 inches) from rod. EFFECTS.—Discharge passed between rod and pipe and destroyed several lengths of latter. [L.R.C. 236. Professor Kirchoff.]

(130) GRATZ, PRUSSIA. 1879. Private house. Had a *lightning-rod;* the *gas pipes* were laid adjacent to the rod. EFFECTS.—The discharge passed between rod and pipes and an explosion ensued. [L.R.C. 236. Professor Kirchoff.]

(131) DUSSELDORF, PRUSSIA. July 23rd, 1878. New art academy. Had a *lightning-rod*, which was connected to *gas and water pipes.* EFFECTS.—Rod struck. [L.R.C. 237. Professor Kirchoff.]

(132) STEGLITZ, PRUSSIA. August 19th, 1879. Private house. Had a *lightning-rod* which was united to *gas and water pipes.* EFFECTS.—Rod struck. [L.R.C., 237. Prof. Kirchoff.]

(133) KRASNOJE-SELO, RUSSIA. August 1883. Stable with *iron hay-rack* along wall. EFFECTS.—All the horses at the rack thrown down, 16 killed. All the hay in the rack set on fire. [Times 13/8/83. (Petersberger Zeitung.)]

(134) CHADDERTON, OLDHAM. July 13th, 1880 and July 5th, 1881. Swan cotton mill. Large building. Internal supports consisted of *C. I. columns.* Numerous *iron gutters* on top. Round building were large *iron gas pipes.* In a cellar a large 400-light gas meter. EFFECTS.—On 1st date meter exploded. On 2nd date, above injuries having been repaired, precisely same event occurred again. [L.R.C., 239. Mr. J. Doherty, A.S.T.E.]

(135) KONGSBERG CHURCH, NORWAY. 1852. Two copper *lightning-rods* connected with *iron rod,* carrying vane and surmounted by a *gilt cross.* EFFECTS—One rod "disabled." No "material" injury done to tower. [L.R.C., 107. H. Mohn of Kristiania, 1875.]

(136) BRÖNÖ CHURCH, NORWAY. October 17th, 1872. Had a *lightning-rod.* Rusty at junction

with ground. Effects.—Church "destroyed." [L.R.C., 107. H. Mohn of Kristiania, 1875.]

(138) PONTYPRIDD. Jany. 30th, 1883. Farmer's house. Effects.—*Chimney* struck and mantelpiece knocked down. Bedroom windows smashed. 5 cows in an adjoining outhouse killed. [Knowledge, 9/2/83.]

(140) STOCKPORT. May 3rd, 1882. Hotel. Effects.—*Gas pipe* near roof melted, and roof set on fire. *Chimney* stack struck. [Elect., 6/5/82.]

(142) WEST HARTLEPOOL. May 2nd, 1882. New Presbyterian Church. Had *lightning-rod* on steeple. An iron *rainwater pipe* at nave. Effects.—Much damage done to building adjacent to water-pipe. Discharge passed between pipe and rod. [Daily Chron., 4/5/82.]

(150) LIVERSEDGE, YORKSHIRE. July 2nd, 1882. Christ Church. Effects.—*Spouting* "demolished." A large stone in tower "driven from one "side to the other." [Stand., 3/7/82.]

(156) PORTSMOUTH. August 12th, 1882. Brewery. Effects.—*Chimney* stack struck. Roofs of brewery and adjacent house smashed. [Stand., 14/8/82.]

(163) NUNEATON. Sept. 27th, 1882. Residence of Rev. J. Davenport. Effects.—Tiles "stripped" from roof, and *chimney* struck. [Stand., 28/9/82.]

(164) NUNEATON. Sept. 27th, 1882. Residence of Miss Minardin. Miss M. sitting in kitchen. Effects.—Miss M.'s clothing and hair scorched. *Chimney* pot of kitchen chimney split. [Stand. 28/9/82.]

(170) SPRINGFIELD, OHIO, U.S.A. April 2nd, 1878. House of Mr. George Reed. Had 4 *iron lightning-rods*, "well connected to the earth." Effects.—House badly damaged inside. [Circular of J. C. Chambers & Co. (Cincinnati, 1882), 28.]

(171) URBANA, OHIO, U.S.A. May 25th, 1878. Court House. Had *iron lightning-rod* "well connected with the earth." Effects.—Stroke passed "through an "18 inch wall in the witness room, scattering brickbats "and mortar all over the room." Tip of rod torn off. [*Ditto, Ditto.*]

(172) NEWPORT, KENTUCKY, U.S.A. June 22nd, 1878. House of Captain James Keniston. Had *iron lightning-rod* fixed by insulators "with a good ground connection in perfect order." Effects.—A hole torn in wall of hall. A brick wall in bedroom pierced and plastering broken through. One of points of rod burnt. [*Ditto, Ditto.*]

(173) WHEATLAND, INDIANA, U.S.A. April 2nd, 1879. School house. Had *iron lightning-rod* with earth connections. Effects.—House "entirely destroyed." [*Ditto, Ditto*, 29.]

(176) ISLE OF SHAPENSEY, ORKNEYS. Dec. 12th, 1882. Farmhouse. Effects.—Seven persons seated round kitchen fire all seriously injured. *Chimney* struck. [Newc. D. C. 12/12/82.]

(180) SLOUGH FORT. July 5th, 1881. Powder magazines. Had 5 copper *lightning-rods*. Effects.—One of rods struck and the adjacent masonry slightly damaged. [Report to W. O. by Major Armstrong, R.E. 24/12/81.]

(181) ROSHERVILLE CHURCH, near GRAVESEND. (No date given.) Had a *lightning-rod* on spire. Effects.—West gable of South aisle close to tower and spire struck. [L.R.C., 34. Mr. A. J. Baker, A.R.I.B.A.]

(182) ST. SEPULCHRE'S CHURCH, NORTHAMPTON. May, 1851. Spire with *vane*. Effects.—A *gas pipe* struck, also face of adjacent *clock*, frame of a window in spire, and rod of vane. (No damage recorded.) [L.R.C. 37, and letter. Mr. E. T. Law.]

(183) FOREST HILL, SURREY. About 1865. Private house. Effects.—Windows below a *chimney* stack broken. *Gilt* bead under cornice of room blackened. *Rainwater down pipe* and *eaves-gutter* struck. Brickwork adjacent slightly damaged. Chimney stack struck. [L.R.C., 38, and letter. Professor T. Hayter Lewis, F.S.A., F.R.I.B.A.]

Note.—Probably a multiple stroke.

(184) JERSEY CITY, U.S.A. May 10th, 1883. Standard Oil Company's Works. Effects.—Huge *iron tank* struck and oil ignited. [Stand., 11/5/83.]

(186) HOLBORN UNION INFIRMARY, UPPER HOLLOWAY. June 23rd, 1878. During erection, roof had only some timbers, *lead work* at apex, and gilt iron *vane* fixed. Hips of roof bolted together with *iron bolts*. Building had *rainwater down pipes*. Effects.—Slight charring to wood at each of hip bolts. Three out of the four hips were much torn and shattered. Vane and lead work at apex not damaged. [L.R.C., 39, and letter. Mr. H. S. Snell, F.R.I.B.A.]

(187) EDGE HILL. June 20th, 1821. Edge Vale. House of Mrs. Clare. Effects.—(1) The stroke pierced the wall at one side of door, tore the wood and brickwork, and shook the fanlight to pieces, burning part of the frame. In kitchen door a *nail* was torn out. (2) Piercing the arch of doorway the stroke split the bricks at bottom of middle window, the glass of which was shattered, and the whole frame dislodged and forced into the house. Over the window also a large hole was forced. (3) In a lower room *gilding* of *looking glass* was scorched and top ornament of it peeled, and six squares of glass were driven out. (4) In room above, door was found partly locked, as if *lock* had attracted stroke. Window frame of an adjacent room forced in. In another room, on 1st floor, in which were no marks, a young lady was knocked down. (5) At the roof, the ridge stones were displaced "the *lead* in many places forced up, and the *cans* of the *chimney stack* shattered." (6) At the next house the *gilding* of a *large pier glass* was streaked with soot, and the frame perforated. [Howard, III. 54.]

Note.—It is clear that the narrator deemed the force of the stroke to have been upward.

(189) RYCROFT CHAPEL, GLOUCESTER. July 1859. Effects.—Iron *down pipe* burst at joints. A hole 10 inches deep rent in the adjacent wall. Metal *eaves-gutter* above struck. Stone edging of roof broken. An adjacent elm-tree had a bough broken off. [L.R.C., 46. Mr. G. J. Symons, F.R.S.]

(190) SCHLESWIG-HOLSTEIN. About 1879. A windmill. Had a *lightning-rod* with *platinum* point. Effects.—Rod struck and point fused. [L.R.C., 128. Dr. L. Weber, 1880.]

(191) SCHLESWIG-HOLSTEIN. About 1879. A private house. Had *two separate lightning-rods*, each ending in copper plates in underground water. House had thatched roof. Effects.—Both rods struck. [L. R. C., 128. Dr. L. Weber 1880.]

(192) SCHLESWIG-HOLSTEIN. About 1879. A school-house with church adjoining. In school-house were several *gas brackets* and the *pipes* were in connection with the ground. A *lightning-rod* on church not connected to gas pipes, and an *anchor* in church wall, distant 9 ft. 9 in. EFFECTS.—Ceiling of school-house above gas brackets pierced. Anchor magnetized and rod struck. [L.R.C., 128. Dr. L. Weber, 1880.]

(193) SCHLESWIG-HOLSTEIN. About 1879. A church. Had *lightning-rod* connected to two large *iron supports* running through steeple and leading to earth. At 100 feet distance was the *gilt* altar resting on ground. EFFECTS.—Altar gilding blackened. Traces on stucco ceiling of church. Outer wall pierced near an *iron window frame.* Iron supports and rod struck. [L.R.C., 128. D. L. Weber, 1882.]

(196) GREAT MALVERN. July 1st, 1826. A small circular shelter hut of granite, roof of *sheet iron.* A stone table in the middle. EFFECTS.—(1) Three ladies seated at the table were all thrown down, and two of them killed. (2) A large crack was made in wall near ground to the frame of a small window, above which the iron roof was a little indented. [Ed. Journ., Sc. N.S. x., 83. Mr. J. Williams.]

(211) STOCKPORT. August 25th, 1807. A cotton mill. *Packing press* containing much iron-work. EFFECTS.—Press much burnt. Building set on fire. Slates on roof shivered. [Howard, II. 25.]

(214) BRIDGNORTH. July 15th, 1808. House in lower part of town. EFFECTS.—(1) Windows and 3 doors in a bedroom over kitchen "demolished." (2) Large part of *chimney* carried away. [Howard, II. 51.]

(231) ARDERSIER, NEAR CAMPBELTOWN. Sept. 1st, 1824. A house occupied by Miss Bremner. EFFECTS.—(1) In kitchen, where Miss B. was sitting, the stroke "ploughed up the clay floor." (2) Gable "wall of house rent nearly from foundation to ridge. "There were three holes in line of rent enlarging inwards." (3) In a room near one hole the glass and *gilt* ornaments of a *clock* were broken and works injured. (4) In attic a window was smashed, some *brass nails* in the chairs were extracted and driven into a chest on opposite side of the room. (5) The *chimney* stack at west end was thrown down. [Howard, III. 161.]

NOTE.—Chimney stack thrown down probably contained kitchen flue.

(239) NEWCASTLE-ON-TYNE. August 3rd, 1809. House of Mr. David Sutton. EFFECTS.—(1) Boards of staircase "torn up." (2) "Every inch of the *bellwires* was oxydised and dispersed in beautiful mossy ramifications on the walls." (3) The *chimney* was thrown down. [Howard II., 85. Mr. Luke Howard, F.R.S., after a visit to scene.]

(240) ILFORD. July 25th, 1810. A private house. EFFECTS—Some *bellwires* were melted into globules. [Howard II., 113. Mr. L. Howard, F.R.S., after visiting scene.]

(245) EAST THRISTON. June 4th, 1810. House of Mr. Cowen. EFFECTS—(1) The *bellwires* of three rooms melted. [Howard II., 109. (Public ledger).]

(258) ST. NICHOLAS CHURCH, STRALSUND. June 19th, 1670. With two steeples. EFFECTS—(1) At altar two *chalices* were thrown down, and a strong piece of wainscot behind, with a picture on it, was split in two. (2) At west end of church the brass and iron work of *clock* was broken. *Gilt figures* so soiled as to be scarcely discernible. The *lock* of a pew near organ thrown out. Gilt *weathercocks* on both steeples smutted on one side of their tails. [Phil. Trans. v., H.A. I. 526 (From a narrative printed at Stralsund by authority).]

(259) ABERDEEN. July 24, 1695. Schoolhouse near that town. EFFECTS—Four breaches made in the walls, *chimney* split in pieces. A hole in the roof just like the shape of a cannon ball. [Phil. Trans. XIX., H.A., IV., 109. A letter to Dr. George Garden.]

(263) QUARRY HILL, near LEEDS. April 27th, 1700. A cottage. EFFECTS—In lower room several holes melted in two *pewter dishes* and in a *tin vessel.* Parts of a *pewter candlestick* and of a *brass mortar* also melted. Part of *chimney* broken down. [Phil. Trans. XXII., 577, H.A., IV., 501. Mr. R. Thoresby, F.R.S.]

(265) NEW FORGE, Co. DOWN. August 9th, 1707. House of Mrs. Close. EFFECTS—(1) In kitchen. The *pewter*, *brass*, and *iron* articles were thrown down. (2) In bedroom over kitchen and under roof, rent made in plaster of gable wall behind *looking glass*, which was broken into pieces. (3) Part of cornice of *chimney* in gable wall (containing flue of Mrs. C.'s room below) was broken off. [Phil. Trans. XXVI., 36, H.A., V., 394. Mr. S. Molyneux.]

(268) SAMFORD COURTNEY, DEVONSHIRE. October 7th, 1711. Parish Church. *Bell* ringers in belfry. EFFECTS—(1) A bell ringer injured, large beam supporting a bell was broken and bell fell on floor. (2) One of the pinnacles of the tower carried away. [Phil. Trans. XXVII., 518, H.A., V., 702. Mr. J. Chamberlayne, F.R.S. (communicated by the clergyman).]

(269) WORCESTER. June 10th, 1824. Private house. EFFECTS—(1) A lady seated at parlour window killed. A large *looking glass* in same room "was lifted off the *hooks.*" (2) A *leaden spout* twisted, and a *chimney stack* adjacent cracked. [Phil. Trans. XXXIV., 118, H.A. VII. 151. Dr. R. Beard, M.D., F.R.S.]

(270) PENCARREG. CARMARTHENSHIRE. Dec. 6th, 1729. Cottage of William Morgan. EFFECTS—(1) A deep hole formed in the earth outside south wall close to *hearth.* (2) The east wall also was struck near foundation, the thick hearthstone split in two. (3) A woman entering cottage with *pail* of water in her hand thrown down senseless and wounded, and the pail shattered. Her two children also wounded. (4) "Dishes and *spoons*, &c. blown off, and found "in the garden on the north side of the house split "and broken." [Phil. Tran. XXXVI., 444, H.A., VII., 437. Mr. Evan Davies.]

(271) STREATHAM. June 12th, 1748. Mr. Howard's public house. EFFECTS—A *nail* in shutter of door forced in. *Iron pin* holding *iron bar* on door post driven out. Bar bent and melted. "A "*sheet of lead* on the pediment over the door was "raised and partly rolled up." Tiling over pediment loosened. [Phil. Trans. XLV., 383, H.A., IX., 328. Rev. H. Miles, D.D.]

(272) PORTSMOUTH, NEW HAMPSHIRE, N.A. May 7th, 1754. Chapel with steeple. EFFECTS—(1) "The floor in west end was hove up." Corner of S.W. angle post of tower below steeple (containing *bell*) shivered. (2) Steeple from the bell cupola upwards rent in pieces. [Gent. Mag. XXIX., 355. (Letter from Portsmouth, N.H., of May 11th, 1759).]

NOTE.—Probably a wooden building.

(273) TRYTHAL, NEAR MOELFRA HILL, CORNWALL. December 20th, 1752. Farmhouse. EFFECTS—(1) Kitchen. A "*brand iron*" that hung in *chimney* was thrown down. Farmer and wife sitting before fire were thrown down, and her shoes (buckled on her feet) were forced off. Farmer's son killed. (2) Room over kitchen. In a boarded closet near chimney all the boards were broken to pieces. (3) Chimney stack of hewn stone, four feet high and four feet square was carried clear off from the house and "thrown twenty feet." [Phil. Trans. XLVIII., 86, H.A., X., 335. Rev. W. Borlase, M.D., F.R.S.]

(275) DANISH CHURCH, WELLCLOSE SQUARE, LONDON. November 17th, 1755. With a *belfry*. EFFECTS—*Wire* and *chain* between *clock* in belfry and *clapper* in turret melted. A small *iron bar* from clock melted half through. [Phil. Trans. XLIX., 298, H.A., X., 629. Mr. G. Brander.]

(276) DORKING, SURREY. July 16th, 1750. Ironmonger's shop. EFFECTS (1) In the shop some long *pendulums* on shelves had their springs melted. Seven "*box irons*" were pierced. Some *nails* in parcels were fused together. (2) In room above plastering of wall torn away, the glasses of several *barometers* hanging against chimney shattered to pieces, and *bell wire* struck. (3) In adjacent room *bell wires* melted. On same floor roof pierced near *bell crank*. (4) *Chimney stack* struck. [Phil. Trans. XLIX., 309, H.A., X., 634. Mr. W. Child.]

(277) GOAT STREET, SOUTHWARK. July 16th, 1759. EFFECTS—(1) A timber house much split and shattered. (2) A second house was set on fire. The *bell wires* in the rooms were melted and scattered all round. (3) In a third house the *bell wires* in like manner were destroyed. (4) In another house, about 220 yards distant, six dozen of port wine in an arched vault were broken to pieces. The bottles were in a large tub bound with *iron hoops*. [Phil. Trans. LI., 286, H.A., XI., 393. Mr. W. Mountaine, F.R.S.]

(279) LOSTWITHIEL, CORNWALL. January 25th, 1757. Parish church, with a square tower; a spire with a copper *vane*; total height, 113 feet. EFFECTS. —(1) "In the ground floor of the tower one of the "stones of the pavement was thrown up." All the windows of the church were either broken or bulged outwards. (2) In clock floor *pendulum crutch* cut through, and 2 *dials* of clock forced off. (3) In bell-room above, the *wheels* of each of the 4 *bells* were broken to pieces, and one of the *iron straps* was unhooked. (4) Lantern at the top, in which is a *bell*, was much damaged. (5) The whole of spire much cracked and damaged, and above 20 ft. of top thrown to a great distance. (6) The vane was thrown down. All the stones surrounding a stay bar except one were broken off. [Phil. Trans. L., 198, H.A., XI., 113. Gent. Mag. XXVIII., 427.]

(280) SANDLING'S FERRY, NORWICH. July 13th, 1758. A small house. EFFECTS.—(1) Kitchen walls damaged, six dishes, two plates, and a basin, all of *pewter*, were superficially melted, and two of the dishes were thrown down. A woman scorched and bruised. (2) Room above. Plaster torn off walls, floor board lifted up, small hole burnt in ceiling above, and tiles of adjacent roof stripped off. [Phil. Trans. LI., 38, H.A., XI., 327. Mr. S. Cooper and Mr. W. Ardesson, F.R.S.]

(281) SOUTH WEALD, ESSEX. June 18th, 1764. Parish church. Tower at west end, with *lead roof* and *weathercock*. EFFECTS.—(1) Between ground and west window, close to tower, the wall was "chipped "here and there," and at bottom of the window bars several stones were cracked. Plaster torn off wall near top of window adjacent to bottom of a *lead spout*. From leads of tower to top of turret a breach made about 4ft. wide. Weathercock unhurt. (2) Stones at bottom of *iron vertical bars* on east window damaged. A *lead spout* over this window rested on a buttress which was cracked. (3) Inside was a large wooden table, supported by an *iron holdfast*, round which plaster was torn off and adjacent woodwork shattered. [Phil. Trans. LIV., 198, H.A., XII., 126. Mr. W. Heberden, M.D., F.R.S.]

(282) ESSEX STREET, STRAND, LONDON. June 18th, 1764. Continuous leaden *eaves-gutter* on each side. EFFECTS.—(1) Bottom house on west side had *chimney* stack shattered. (2) At a house 30 yards higher up a wooden case at bottom of a *lead pipe* was torn. (3) On east side at bottom house some steps adjacent to a *leaden water pipe* and some *iron balusters* were damaged. (4) On same side, at a point 70 yards higher up, a piece of pavement, near some *iron railings*, was broken off. [Phil. Trans. LIV., 235, H.A., XII. 144. Mr. T. Lawrence, M.D.]

(286) PEMBROKE COLLEGE, OXFORD. June 3rd, 1765. EFFECTS.—(1) A hole made from ground through ground floor of room on south side. Near corner of iron frame of south window a round hole made through stonework, and an iron bar carried into the room. (2) In room above south window where casement was of iron, woodwork near window was much damaged, and a "beaufet" had its *brass escutcheons* all forced off. The tops of some *canisters* inside were taken off, and some *teaspoons* blackened. (3) In garret above an oak post full of *nails* was shattered to pieces, and the north window was "blown outwards." (4) The *chimney stack* on south side above garret was thrown down. (5) At another garret 40 ft. distance, containing a heap of old *iron casements*, a stone was cut out of the wall at the bottom of an iron cramp, at top of which the wall was pierced. [Phil. Trans. LV., 273, H.A., XII., 254. Mr. Griffiths.]

(288) ST. KEVERNE'S, CORNWALL. Feb. 18th, 1770. Parish church, with tower, containing *bells*, with a *lead roof* and a spire, with *iron spindle* and *weathercock*. EFFECTS.—(1) Seat near reading desk torn to pieces and scorched. (2) Two places pierced in roof; belfry window shattered to pieces; *bells* not damaged; arch stone of belfry door, cramped with lead, shattered, and the *lead* melted. From this arch to battlements of roof wall of tower thrown down. The *lead on top of tower* was partly melted and rolled together. (3) The lower half of spire was cracked, and its upper half thrown to a great distance. [Phil. Trans. LXI., 71, H.A., XII., 98. Rev. Anthony Williams, Vicar of St. Keverne's.]

(290) WHITFIELD'S CHAPEL, TOTTENHAM COURT ROAD, LONDON. March 18th, 1772 (Sunday). Part struck was inferior in height to the main building. On summit was a wooden ornament in two pieces, joined together by *iron spikes*. This rested on a wood plinth covered with *lead*, which was connected to the *lead hips* and to a *lead gutter*, in which was a lantern containing *clock bell*. A small *lead pipe* was soldered to gutter, and through this went

an *iron wire* connected with the tail of hammer, and passing within a few inches of the *striking rod of clock*, to which it was tied by a string. Effects.—(1) A man sitting close to door killed. A large piece was struck out of door, and an *iron handle* melted: wooden water shoot connected at top with a *leaden pipe* was rent. (2) A window frame over door burnt; the *iron bar* at centre of window partly melted; adjacent *leadwork* melted. (3) *Ball of clock pendulum* and striking rod of clock partly melted; iron wire melted; clock hammer wire melted about half through, diameter of which was here less than 1-12th inch. [Phil. Trans. LXII., 131, H.A., XIII., 307. Mr. Henley.]

(292) STRASBURG CATHEDRAL. August 14th, 1833. (3rd time.) Effects.—(1) The *lead, copper*, and *iron* of tower were melted in several places. The hammers were soldered to the several *bells*. [Elect. Mag. I. 154.]

(293) VAUXHALL, LONDON. July 28th, 1842. White lead factory. *Boiler chimney* with massive iron cap, brickwork *clamped with iron*. Effects.—Great havoc made in several of the chimney courses. Track of stroke outside shaft was of a spiral form. [Elect. Mag. I., 310. Mr. C. V. Walker, F.R.S. (editor), after examination.]

(294) GAIS, APPENZEL, SWITZERLAND. 1873. Effects.—Two chalets, each defended with two iron *lightning-rods*, were burned to the ground. [Journ. Roy. Met. Soc. II., 432. Dr. C. J. B. Williams.]

(297) CHALUSSET, NEAR CLERMONT-FERRAND, FRANCE. October, 1848. A cottage. Effects.—A double hole pierced through wall at a point where a large *iron implement* was hanging inside, and a child close by killed. [Comptes Rendus xxviii., 136. M. Désormery.]

(299) ATTLEBOROUGH, MASS., U.S.A. July 1st, 1851. Wooden house. Effects.—(1) 1st stroke, several weather-boards were torn, the line of *nails* being followed. (2) 2nd stroke 3 minutes after the first, weather-boarding again torn, a *mirror* hanging inside was broken. Several persons knocked down and scorched. (3) In attic above were an *iron pan*, a *long iron rod*, and 4 *iron hooks* hanging. Over these metals the roof of same gable was damaged. [Amer. Journ. Sciences XII., 239. Mr. H. Rice.]

(300) CAMBERWELL, LONDON. 1870. Private house. Effects.—An *eaves-gutter* above a *rain-water pipe* damaged. *Chimney* stack damaged. [L.R.C., 39, and letter. Mr. Wyatt Papworth, F.R.I.B.A.]

(302) HAVANNAH. June 30th, 1851. Private house. Effects.—A brick wall adjacent to the *iron bars* of one of the windows was pierced by a square hole, and the heads of two small columns of a "terrasse" which supported an iron *balustrade* were raised. [Comptes Rendus XXXIII., 209. M. Casaseca.]

(303) TOUCY, YONNE, FRANCE. January 25th, 1878. Church with tower containing *bells* and wooden steeple, surmounted by a *cross*. Effects.—Set on fire in two places and "completely burnt." [Comptes Rendus LXXXVI., 526. M. L. Roché.]

(308) RICKMANSWORTH, HERTFORDSHIRE. July 16th, 1759. House of Mr. Whitfield. Effects.—Windows on one side broken, and a *chimney* stack rent, the bricks being thrown to a great distance. [Gent. Mag. XXIX., 343. Phil. Trans. LI., 282. H.A., XI., 392. Mr. J. Van Rixtel, F.R.S.]

(309) CHESTER ROAD, MANCHESTER. June 3rd, 1848. The "Northumberland Arms. A *lightning-rod* was fixed to one chimney stack projecting 6 feet above it, and 15 feet distant from kitchen chimney. In cellar below kitchen was an *iron gas main* connected to the ground. Effects.—(1) A *brass coupling joint* of gas main in cellar was blown off, and the gas ignited. (2) A *gas tube* in kitchen was struck, as also were the *grate* and chimney flue. The kitchen was the only room in which a fire was burning. (3) The kitchen *chimney* stack above was shattered. [Proc. L. & P. Soc., Manch., 2nd series, IX., 56. Mr. William Sturgeon who visited scene a few days afterwards.]

(310) SALFORD. August 16th, 1849. Machine Works. *Boiler chimney*. Fitted with an iron *lightning-rod*. Heavy stone cap, held together by a *cylindrical iron band*. The lightning-rod passed through a projecting moulding of one of these stones. Effects.—At 2 or 3 feet from the lightning-rod 2 of the coping stones were shattered into fragments, which fell through the roofs of the works. [Proc. L. & P. Soc., Manch., 2nd series, IX. 60. Mr. William Sturgeon after examination.]

(311) OSBORNE HOUSE (H. M. RESIDENCE). June 8th, 1849. Had 8 copper *lightning-rods* attached to different parts of the building. There were also several *C. I. water pipes* between roof and underground drains. The highest rod was 30 feet higher than the clock tower, from which it was 220 feet distant. The nearest rod to clock tower was 152 feet distant, but lower. Effects.—The clock tower was struck at the summit of one of its angles, about 56 feet horizontally distant from top of nearest C. I. rain-water pipe. [Proc. L. & P. Soc., Manch., 2nd series, IX., 61. Mr. William Sturgeon.]

(312) ST. MICHAEL'S CHURCH, LIVERPOOL. August 23rd, 1841. Spire surmounted by *metal cross* on a *bronze ball* all *richly gilded*. Supported by an *interior copper bar*, on the apex of the masonry. This bar 40 feet long, rested on 2 *horizontal iron bars* fixed in the spire. The stones of spire were held together by *copper cramps* secured by *lead*, and there were long *strips of lead* in the joints. Effects.—Two great rents 24 feet long, diametrically opposite each other were made in the spire. The upper part was left very shaky. Ball and lower end of shank of cross discoloured. [Proc. L. & P. Soc., Manch., 2nd series, IX. 72. Mr. William Sturgeon.]

(328) ST. CHAD'S CHURCH, CHEETHAM HILL ROAD, MANCHESTER. May 23rd, 1850. With tower and spire turret. Parapet of tower bound by *iron cramps*. A *lead gutter* on tower leading to a C. I. *down pipe* inside tower at one angle. This pipe led to *lead gutters* round main roof, which were connected to other *C. I. pipes* leading to ground. Effects.—Several lengths of C. I. pipes inside tower damaged at junctions. Masonry of parapet rent between several iron cramps. Spire turret struck. [Proc. L. & P. Soc., Manch., 2nd series, XIV. 17. Mr. William Sturgeon.]

(321) ST. MARY'S CHURCH, CRUMPSALL, MANCHESTER. January 4th, 1872. Had a tower and spire. Outside spire was a *copper lightning-rod*, the lower end of which passed through an iron *rain-water down pipe* and ended in a common drain 18 inches below the ground, a *leaden down pipe* inside vestry passed through wall 18 inches above floor, and below this floor there was a *lead gas pipe* connected

with meter. Effects.—The leaden gas pipe was melted. The church set on fire and the interior completely gutted. Two stained windows, probably with the usual wire guards, were demolished. Cost of damages, £3000. [Proc. L. & P. Soc., Manch., xi., 92. Mr. Joseph Baxendale, F.R.A.S., after examination. Builder, 20/1/72.]

(322) OLDHAM. 1861. *Boiler chimney.* Had a copper *lightning-rod.* Close to and parallel with rod an iron *wire rope* descended from near the top of chimney for 100 feet, and was secured to an *iron bolt,* inserted in chimney about 10 feet above the ground. At 16 feet distance from bottom of wire rope was a *gas meter* in a cellar. Effects.—Lead pipe connections at meter fused, gas ignited, and wire rope struck. [Proc. L. & P. Soc., Manch., xi., 70. Mr. Henry Wilde.]

(323). ST. PAUL'S CHURCH, KERSAL MOOR, MANCHESTER. Summer, 1863. Had a copper *lightning-rod,* the lower end of which extended underground for a distance of 20 feet. Inside tower was a small *gas pipe.* Effects.—At 5 feet above the ground a hole was pierced through the 4 foot wall of the tower between the gas pipe and the lightning-rod, and a stone fractured. [Proc. L. & P. Soc., Manch., xi., 72. Mr. Henry Wilde.]

(329) THE LOUVRE, PARIS. April 23rd, 1840. Had *lightning-rods.* Effects. — One was struck. [Comptes Rendus xii., 798. M. Sellier.]

(333) STRASBURG CATHEDRAL. July 10th, 1843. (5th time.) Had 3 *iron lightning-rods.* (*a*) On summit of pyramid of tower. (*b*) On guard house. (*c*) On choir. Separated by a passage from the cathedral was a tinman's shop in which was a very large quantity of metal. The roof of the nave was of *copper.* All the *metallic surfaces* of the cathedral were united together and with the general system of lightning-rods. Effects.—Cathedral struck twice at an interval of 1 minute. The *platinum* point at the top of one of the rods was melted about ¼ inch. No damage to building. [Elect. Mag. i., 154. M. Fargeaud.]

(338) PARELL, BOMBAY. 1832. House of Sir Colin Halkett. Effects.— Great damage. *Plate* on sideboard melted. [B.A.R., 1855, 98. Appendix to report of Professor Baden Powell, F.R.S., on luminous meteors.]

(341) KIMBLESWORTH COLLIERY, DURHAM. July 12th, 1880. Colliery office with *telegraph wires* connected thereto and surmounted by a *lightning-rod* on a *telegraph pole.* Effects.—(1) Walls inside scored deeply, and several of the wires melted. Corner of office where wires enter it damaged. (2) Lightning-rod "destroyed." All the wires within 110 yards of the office had to be renewed. [Trans. N. of E. Inst. Min. and Mech. Eng. xxx., 129. Mr. John Daglish. (Mr. Tate, colliery manager).]

(342) NELSON'S MONUMENT, CARLTON HILL, EDINBURGH. February 4th, 1863. Two stories high. Roof of lower story covered with *lead,* and underneath was a *gas pipe of block tin.* Effects.—Gas pipe melted for a length of 9 feet, and over each extremity of this length a hole was pierced through lead covering. Gas ignited and rafters set on fire. Upper story of monument untouched. [Proc. R.S.E. v., 105. Professor C. Piazzi Smyth.]

(346) GOVERNMENT HOUSE, CALCUTTA. March 30th, 1838. Has a *copper-covered dome,* surmounted by a statue holding a sharply-pointed *iron spear.* The shoulders of statue studded with *iron nails.* There were 4 *regular lightning-rods* on building. (Apparently the spear and dome acted as upper portions of what was practically a fifth rod). Below dome was a ball-room. Effects.—(1) Several panes of glass in ball-room and one *pier-glass* broken. (2) The spear was "demolished." [Phil. Mag. xxiii., 177. Dr. O'Shaughnessy, M.D., F.R.S.]

(347) ST. THIBAUD DE COUZ, NEAR CHERBOURG. June 14th, 1846. Parish church. Effects. —*Gilt frame* of a large picture and six *gilt chandeliers* blackened. [Phil. Mag. xxx., 222.]

(348) NOS. 20, 21, and 22, WEST-STREET, WHITECHAPEL, LONDON. July 26th, 1849. Gable end of No. 22 contained *chimney flues. Iron rainwater pipes* in front conveyed water from a *lead or zinc gutter* as low as doorheads, where they were replaced by wooden spouts. Effects.—(1) At No. 22 gable wall so shaken that it had to be taken down and rebuilt. Lower wood spout in front torn away. (2) The wood spout between Nos. 20 and 21 was thrust about 3 or 4 inches from the wall, and front wall of No. 21 perforated. (3) At No. 17 a man who at the time was opening the front door was killed. [Phil. Mag. xxxv., 161. Mr. W. Radcliff Birt.]

(352) HORROCKS FIELD, LANCASHIRE. July 16th, 1850. Farmhouse. Effects.—Two girls killed. Floor of kitchen pierced. Roof pierced and *chimney* struck. [Phil. Mag. xxxvii., 329. Mr. Peter Clare, F.R.A.S.]

(356) LEFTWICH CHURCH, LANCASHIRE. July 16th, 1850. Had a *metal eaves-gutter,* and *rain-water pipe* thence to the ground. Effects.—At gable end, near to this gutter and pipe, a quantity of stone was forced off. [Phil. Mag. xxxvii., 329. Mr. P. Clare, F.R.A.S.]

(357) DAVENHAM CHURCH, LANCASHIRE. July 16th, 1850. Had a spire with *vane* and *spindle* of copper bolted through the solid stonework. Below spire on outside of tower was an *iron pipe.* Effects. —(1) At bottom of tower near this pipe (and just above ground) the stonework was damaged. (2) At bottom of spire a large breach was made in the masonry. Just below bottom of spindle a hole was made in the spire. [Phil. Mag. xxxvii., 329. Mr. P. Clare, F.R.A.S.]

(359) AUGUSTA, U.S.A. June 25th, 1803. House of Mr. Martin. Effects.—In a bedroom a *looking-glass* hanging at foot of bed was dashed to pieces. In a chest of drawers were some *pewter spoons,* which were partially melted. Over the chest hung a carpenter's *iron square.* [Phil. Mag. xvii., 306. Mr. Isaiah Gilbert.]

Note.—Probably the house was of wood.

(369) GENEVA. July 3rd, 1822. A private house. Roof covered with *tin,* which was connected by a *tin bar* to the ground. Effects.—A piece of tin was perforated with 2 holes, 1 inch in diameter and 5 inches distant. [Ed. Phil. Journ. vi., 379. Professor Pictet.]

(370) ST. ANDREW'S CHURCH, WORCESTER. Dec. 14th, 1825. Had a tower, lofty spire and *weather-cock.* Effects.—A large rent on side of spire half-way between tower and weathercock. [Ed. Journ. Sciences, N.S., x., 81. Mr. J. Williams.]

(375) SANDWICH, KENT. July 3rd, 1845. A private house. EFFECTS.—In a bedroom the woodwork of mantelpiece was forced forward. The fireplace had a *Bath stove*. Chimney-pot above forced from "its place," and a large hole made in it. [Elect. Mag. II., 123. Mr. James Layton.]

(378) BRABOURNE, KENT. July, 1846. House of Mr. Thomas Smith. EFFECTS.—House much damaged. In a bedroom the panels of door were forced out. Holes burnt in bedclothes. *Chimney breast* levelled from floor to ceiling. A child hurt by a falling brick. [Elect. Mag. II., 396.]

(386) MANILLA. May 31st, 1879. Binondo Tower. EFFECTS.—Stonework of arch much injured. Crystal shade of *clock* on tower damaged, but mechanism of clock unaffected. [Nat., Aug. 7th, 1879.]

(387) SHEFFIELD. June 5th, 1879. House of Mr. Osbaldistone. Had a copper *lightning-rod* passing through glass insulators. EFFECTS.—At a height of about 9 feet above ground a hole pierced in wall between lightning-rod outside and a *gas pipe* inside beside a *mirror*. Mirror smashed to atoms. Gas pipe melted and gas ignited. *Gilded* ceiling and cornice "destroyed," and floor above "ripped up." Cost of injuries, £500. [Nat., June 12th, 1879. Mr. Newall, F.R.S.]

(388) ST. MARIE'S CHURCH, RUGBY. June 5th, 1879. Had a copper *lightning-rod*, 212 feet high, on spire, which contained a peal of 8 *bells*, with *iron wires* leading from clappers terminating near a soft metal *gas pipe* fixed on wall of organ loft. EFFECTS.—A rent about 1 foot in diameter was made in the stone wall next organ. Gas pipe melted at a T-piece joint, gas ignited, and woodwork set on fire. [Nat., June 12th, 1879. Mr. Newall, F.R.S.]

(398) LUMLEY, NEAR CHESTER-LE-STREET, DURHAM. June 9th, 1883. The "Old Hall." An old stone house, 3 stories high, let in tenements. Two gable ends E. and W., the former partly hidden by an adjoining lower house. House divided by a partition wall into two habitations, of which eastern, where damage occurred, was unoccupied. Steep pantiled roof. A brick *chimney* stack at ridge over partition wall. EFFECTS.—(1) No traces at ground or on ground floor. (2) *First floor.* No ceiling. Girders, joists and flooring of room above visible. On east side of a girder 9½ by 4½ extending from north (front) to south (back) wall of house a splinter of wood 16 inches long and about 1 inch square (on an average) was split off horizontally to a distance of about 4 feet from south wall. Lower down on same girder was a horizontal crack extending from south wall for about 8 feet inward. Close to the west side of this girder was a joist 7 by 3, and about 3 feet long passing through the S. wall, and fixed to the girder by *large trenails.* This joint was forced about 1 inch from the girder, and a horizontal split passed completely through it along the line of heads of the trenails. Underneath this joist a small piece of rotten wood which had been imbedded in the wall was forced into the room, and found on the floor about 4 feet to the N. An irregular patch of damp plaster, about 4 feet by 18 inches which had covered this fid of wood, was torn off, and most of it thrown hard against the opposite (north) wall a distance of about 21 feet. This wall was quite dotted with portions of the damp plaster still adhering, which were chiefly near the ceiling. The intervening floor was also covered with broken plaster. The plaster still adhering on S. wall round edges of patch torn off was saturated with water at the time of visit. (2) *Second floor.* Resting on the girder at a distance of about 10 feet from the south wall, and thus a little to N. of N. end of crack in girder, was the foot of an upright wooden post 8 in. by 3 in., on the top of which rests one of the roof rafters a little above the level of the floor of a loft in the roof, the underside of which forms the ceiling of the second floor. This post is split right up from floor to rafter in two places, and a piece about 7 feet 6 inches long, by 6 inches, by 3 inches, was also completely torn off the N.W. angle, and found lying on the floor a few feet distant. The post forms an angle at the E. side of a porch or dormer in roof. The split follows the line of the *iron nails* of the plaster laths on S. side of room. A great patch of plaster over these laths was torn off, and the lath ends were all forced outward at the line of nails. At top of post the scar left by piece torn out forked in a curious manner, and a small hole was pierced through ceiling. *Four nails* passed through bottom of post and floor, but no sign of fusing is visible on them, nor apparently was any damage whatever done to the floor boards immediately beneath it. A small patch of plaster torn off this dormer wall a little to S. of post, but the exact manner in which stroke arrived at post is not clearly visible. (3) *Roof.* The rafter on south side of roof resting on head of post had two large pieces torn completely out of it from the head of post upwards. One of the scars 3 feet 6 inches long had been cut cleanly from underside of rafter, leaving new surface almost smooth. Another piece, 3 feet by 4 inches by 2 inches, had been cut out alongside first piece and extends a little higher up. At its upper end (at about two-thirds of length of rafters up roofside) was a hole in the roof through the tiles a little below and to eastward of chimney stack. The upper piece cut from rafter was found broken in two lying on the floor about 8 feet distant to N.E. At the E. end of loft was a small window-opening without any window, and through this opening splinters of wood were thrown out into the yard below (some to a distance of 63 feet). The lower piece cut out of rafter could nowhere be found. The hole through roof is pierced at the position of a small *lath nail.* (4) *Chimney stack.* Several courses were dislodged from the top of the chimney stack, and pieces of brick and tile thrown as far as 60 feet. [Scene examined by the writer three days after the stroke occurred, and when it was still unknown (the doors having been locked) that any injury had occurred inside the house.]

NOTE.—No trace of heat could anywhere be discovered.

(401) SALFORD. June 8th, 1883. Worsley Street Mills. *Boiler Chimney.* EFFECTS—*Telephone wires* melted in office. Chimney struck. [Manchester Guardian, 11/6/83.]

(402) PAINSWICK CHURCH, GLOUCESTERSHIRE. June 10th, 1883. Had a spire 175 feet high with a peal of *twelve bells*—EFFECTS—Spire destroyed. "Stones were hurled 80 or 90 yards from the church." [Standard, 12/6/83.]

(403) BASSINGHYLL, WESTMORELAND. June 15th, 1883. Powder mills. A small one-storied wooden building containing *mill-bed, rollers, axles, &c.,* all of metal. A man inside was in the act of spreading a charge on the bed. EFFECTS—The charge was set on fire and exploded. None of the machinery was

injured, and the structural damage to the building was trifling. The man died from the effects of burning. [Report of H.M. Inspector of Explosives, 30/6/83.]

NOTE.—It seems possible that the explosion may have been caused by the spark of an induced discharge, and not by direct action.

(404) CROFT, near BARTON, LANCASHIRE. June 9th, 1883. A wood shed supported by *iron pillars.* EFFECTS—At the foot of an iron pillar two large holes were made in the earth. One of the wooden spars was broken to pieces. [Durham Chronicle, 15/6/83.]

(408) ST. BOTOLPH'S CHURCH, CAMBRIDGE. June 25th, 1883. Tower surmounted by figures. A *rain-water down pipe* attached to tower. EFFECTS—Tower damaged. One of the figures shattered. [Middlesborough News, 30/6/63; Standard, 26/6/83.]

(421) WHITKIRK, near LEEDS. June 30th, 1883. House and shop. EFFECTS—(1) In shop on ground floor woodwork damaged, and stone mantlepiece shattered. (2) In room above *chimney glass* thrown on floor. *Chimney flue* struck. [Yorkshire Post, 3/7/83.]

(426) WHEELDON STREET, SHEFFIELD. July 3rd, 1883. Private house. EFFECTS—(1) In bedroom a *gas bracket* was twisted out of shape, and window forced in. Hole made in ceiling where *gas pipe* entered. (2) In room above a groove made in wall plaster. [Sheffield Daily Telegraph and Leeds Mercury, 4/7/83.]

(429) SOUTH RETFORD, NOTTINGHAMSHIRE. July 3rd, 1883. House in Albert Road. In centre of a row. EFFECTS—(1) Part of staircase ceiling stripped off. (2) Slates "torn up," and part of *chimney* knocked down. [Sheffield Daily Telegraph, 4/7/83.]

(431) FRIOCKHAM, FORFARSHIRE. July 2nd, 1883. Free Church. EFFECTS — Metal *rainwater down pipe* at S.E. corner of building struck. (2) N.E. gable struck. *Gas pipes* in roof struck. Wooden support of one of roof couplers torn to shreds. [Liverpool Mercury, 5/7/83.]

(432) CORBRIDGE, NORTHUMBERLAND. July 3rd, 1883. House at Heron's Hill. EFFECTS—(1) *Lead gas pipe* at bottom of house broken, and gas ignited. *Metal spout* "smashed to pieces." (2) Coping stones covering gable end torn away. Large hole made in roof. [Newcastle Daily Telegraph, 4/7/83.]

(433) STALLINGBOROUGH, near LEEDS. July 3rd, 1883. Parish church with tower under repair. From top of a scaffold pole hung a large *chain*, the bottom being level with top of church door. Inside church a few yards from door was an *iron grating* in floor. EFFECTS—(1) The stroke "split up flagstone at corner of grating," and split one of the doorposts to shivers. (2) Top of a scaffold brace pole contiguous to the chain was shattered, and some brickwork close to it displaced. [Letter to writer from Rev. E. J. Lowe, Vicar of Stallingborough, 31/10/83.]

(436) BELLFIELD STREET, SHEFFIELD. July 4th, 1883. House No. 52. EFFECTS—(1) Bedroom window panes shattered. Brickwork laid bare above head of an *iron bedstead.* (2) In attic above floor pierced, gable shattered. (3) *Chimney* struck. [Sheffield Daily Telegraph, 5/7/83.]

(437) WETHERBY, YORKSHIRE. June 30th, 1883. A farm house. EFFECTS—Wife of farmer with a *frying pan* in her hand knocked down. Pan "doubled up." *Chimney* "demolished." [Scarborough Gazette, 5/7/83.]

(440) WARDLAW FARM, STEWARTON, AYRSHIRE. Farmhouse. At back of house was a large byre, the door of which was close to kitchen door. Above byre door was an *iron stanchion.* EFFECTS — (1) Farmer's wife standing just inside open byre door killed. A black mark across lintel of door passing up to stanchion. [Letter of farmer to writer, 21/7/83.]

(442) WETHERAL ABBEY FARM, CUMBERLAND. July 5th, 1883. EFFECTS—Stable struck. Farmer injured. "*Spout*" shattered. Hole made in roof. [Carlisle Journal, 6/7/83.]

(446) LEEDS PRISON. July 12th, 1883. Large masonry building consisting of a central tower and four wings. Tower much higher than wings, with flagstaff and *lightning-rod.* At outer angles of each wing were ornamental turrets 6ft. higher than roof ridges. The portion of building damaged was the S.E. turret of the east wing. Its horizontal distance from the rod on central tower was about 200 feet. It had no lightning-rod, and the only other rod at the prison was the upper portion of one fixed at the S.W. turret of west wing, about 200 feet further from turret struck than central tower. The main front of the prison (formed by west wing, tower, and east wing) is south. Turret was about 10 feet high from base (at level of eaves-gutter of wing roof), 6 feet square and hollow, the top being covered with flagging, which was surrounded by a low battlemented parapet, some 2 feet high, and 1 feet thick. Built of sandstone coursed ashlar lined with brickwork. On north side a small *lead shoot* or spout about 15in. long, and 6in. wide, projected from level of flagging through parapet about 3in. beyond face of wall. About 1 foot below this the walls of turret were tied by 4 horizontal *iron bands* 2in. by 1/8in., one in each wall, and at a distance of 5 feet lower, the walls were again tied by 4 *similar iron bands.* At base of turret on the north and west sides were *lead flashings* about 6in. high joined to a similar *lead flashing* and lead *eaves-gutter* running along the back of south parapet wall of wing roof. From this gutter at a distance of 4 feet from turret a vertical *lead pipe* conducted the rain water through parapet into hopper head of an ordinary *cast iron down pipe* about 6in. diameter leading to a drain. This pipe about 60 feet long passed about 3 feet from 4 *iron framed and barred* cell windows (1 in each of 4 stories of prison). The ground at the foot of the pipe was of a moist clayey nature. The cloud appears to have approached from about W.N.W. EFFECTS — (1) *Lead flashings.* (*a*) Between opening in gutter for down pipe and turret. Two slight bulges outwards in centre of upper and outer lap of flashing, one with a hole in centre about 1/8in. diameter. First bulge 18in. from down pipe hole. Second 2ft. 2in. further eastward, and 4in. from turret. (*b*) On west side of turret two similar bulges (without holes), one at 2in. south of N.W. angle of turret, and one exactly at angle. (*c*) On north side of turret about 12in. from gable parapet wall at east end of wing roof, and about 2ft. 6in. from N.W. angle of turret, a bright round spot about ¼ inch diameter superficially fused on face of flashing near top. (*d*) At angle of north face of turret with

east gable parapet wall. The flashing here proceeds up slope of roof along back of latter wall. The length of 8 inches of upper lap of this flashing nearest angle was completely turned up at right angles, and the 2in. of this length close to angle were doubled back in a peculiar manner. About 2in. north of rolled-up part was a round hole ½in. diameter, with burs outwards, and about 2in. still further north, another similar hole, and close by another bright round spot of slight fusing about ¼in. diameter, and slightly bulged outwards. (2) *North face of turret.* From the angle last mentioned where flashing was turned up to the lead shoot, which was 8 feet above it, the ashlar (which is about 8in. thick) was completely cut through by an irregular vertical rent about 1in. wide. This rent took the course of the joint in some courses, but in most it cut clean through the stone. Two iron tie bands were cut through. Several stones were torn out, and most of the fragments were thrown to the ground, at a distance from base of turret of from 12 to 20 feet, while two were projected as far as 69 feet. Signs of rust from contact with an iron tie band were visible on the bed of the larger stone. (3) *Roof and walling at S.E. angle.* The east and south walls of turret were forced outwards from the edges of the roof flagging about 6 inches. The lead shoot, flagging, and north and west parapet walls seemed almost uninjured, but the east and south parapets were thrown down for a distance of about 3 feet on each side of the S.E. angle, and the turret walling below them was also thrown or shaken down to a depth of some 7 or 8 feet lower along this angle, the breach thus formed being of a triangular shape when viewed from the S.E., the bottom of the rent depth forming one of the angles. The south and east parapet walls appeared to have been struck obliquely at the back from the direction of the lead shoot at the inside of north parapet. (4) *Interior.* No damage was done to the inside of the prison, nor to the inmates. The cells close to the downpipe were all occupied at the time. [Inspected by writer (at instance of H.M. Prison Commissioners) on July 26th, 1883.]

(453) KINGSTON-ON-THAMES. July 14th, 1883. Parish church. Had tower with flagstaff and *weathercock* secured by *iron stays.* A *rainwater pipe* from tower led to *eaves-gutter* which joined *rainwater pipe* at west end. EFFECTS.—Both rainwater pipes shattered. One of flagstaff stays carried away. Flagstaff split from 9 feet above base upwards. Weathercock turned round. [Newc. D. Journ. 16/7/83, and letter to writer from Rev. A. Young, vicar.]

(456) ST. MATTHEW'S CHURCH, GOSPORT. July 3rd, 1883. At 10 feet from ground was a *gas pipe* inside church. Part of window frames of *lead.* EFFECTS.—The 18-inch outer wall against which gas pipe was fixed was pierced, and the leadwork at some of the windows struck. [Sheffield D. T., 4/7/83. Morn. Post, 17/7/83.]

(463) BLOOMINGTON UNIVERSITY, INDIANA, U.S.A. July 12th, 1883. *Telephone wires* attached. EFFECTS.—Wires struck. New portion of building set on fire and "destroyed." Loss estimated at £50,000. [Globe, 7/8/83.]

(465) NATIONAL DOCKS AND STORAGE COMPANY'S WORKS, NEW YORK. May, 1883. A large brick *tank* full of petroleum oil, plated outside with iron. EFFECTS.—Oil fired, and 26 adjacent tanks also set on fire by the blazing liquid. Six persons burnt to death. [Chambers' Journ., Aug., 1883.]

(469) LICHFIELD. July 2nd, 1883. A vicarage. On one chimney stack was a *lightning-rod.* Another *chimney stack* 20 feet distant without a rod. EFFECTS.—On the first floor the stroke "proceeded to lift the "whole iron horseshoe *grate* from its position, to jump "it (without a scratch or mark of any kind) over a "low fender, and to place it upright—as in an iron-"monger's shop—upon the rug." From the chimney stack above—the one without a rod—some bricks were dislodged.—[Morn. Post, 14/7/83. Canon Curteis, M.A.]

(472) TERREHAUTE, INDIANA, U.S.A. Sept., 1871. Congregational Church. Had an *iron lightning-rod. Gas pipes* inside church near position of rod outside. EFFECTS.—A hole pierced through brick wall between gas pipes and rod. Gas set on fire. A similar hole made in opposite wall. The bricks were thrown inwards. [Chamb. and Co. Circ. (1882), 16, Eng. Mech., 31/5/72. Anderson, 186.]

(473) ATLANTA, GEORGIA, U.S.A. 1873. No. 290, Washington Street. A house with 4 *iron lightning-rods* on it. EFFECTS.—House struck twice in quick succession. Weather-boarding and plastering torn off, *gas pipes* struck and rods melted. [Chamb. and Co. Circ. (1882) 26. Mr. H. P. Farrow, U.S. Dist. Attorney for Georgia.]

(474) TYLDESLEY CHURCH, NEAR MANCHESTER. Nov., 1878. With tall spire. Had an *iron lightning-rod* carried down inside spire to ground. Top attached to a bold *copper finial* on spire, about 150 feet from ground. EFFECTS.—A *gas pipe* in floor of *belfry* melted. Gas ignited, and belfry set on fire. Some beds of masonry in upper part of spire deranged. [L.R.C., 39, and letter to writer from Mr. Wyatt Papworth, F.R.I.B.A.]

(475) ENGLAND. (No date given.) A church with tall spire. Had a *weathercock* and a copper *lightning-rod* attached to *spindle,* passing down inside spire and out at *belfry* window, and thence with several bends into ground. *Bells* connected to it. EFFECTS.—About 20 feet above ground masonry slightly damaged at projections close to a bend in the rod. [L.R.C., 39. Mr. J. L. Pearson, R.A., F.R.I.B.A.]

(476) BETHNAL GREEN, LONDON. About 1843. A four-roomed house. One of a row. With V roof, and an *iron down pipe* at back of house. EFFECTS.—House cut in two, a fissure being made in front and back walls and in middle plaster partition rather to the side of down pipe. (L.R.C., 41. Mr. E. N. Clifton, F.R.I.B.A.]

(477) EAST OF LONDON. 1837. A *boiler chimney,* with *lightning-rod* fixed by *iron staples.* EFFECTS.—The brickwork received a concussion at most if not at all of the staples. [L.R.C., 5.]

(478) ST. MARY'S CHURCH, TAUNTON. 1854. With a *copper lightning-rod* on tower. EFFECTS.—Much damage done to tower and roof of church. [L.R.C., 8.]

(479) WEEK ST. MARY, CORNWALL. October 19th, 1843. Parish church (3rd time). Tower with pinnacles. *Leaden gutter* between nave and north aisle. A *strong vertical iron bar* in front of one window. EFFECTS.—This window much damaged. Wooden framework of all church windows much shaken. Two courses of stone just below south-east pinnacle greatly damaged. South-east pinnacle torn down. [L.R.C., 33. Rev. G. H. Hopkins, rector.]

(480) NORTHAMPTON. July, 1872. A private house, with tower surmounted by *cast iron vane.* The ridge crowned with *cast iron cresting.* A *rainwater pipe* on tower. EFFECTS.—A piece of iron cresting close to tower "hurled some 20 yards from the building." Slates stripped from roof. [L.R.C., 37. Mr. E. J. Law, F.R.I.B.A.]

(481) UNIVERSITY COLLEGE, LONDON. Between 1866 and 1877. Has a stone dome. Also *eaves-gutters* and *rain pipes* entering drains. A *chimney* twice struck. Little damage done. [L.R.C., 38, and letter from Professor T. Hayter Lewis, F.S.A., F.R.I.B.A.]

(482) EALING, NEAR LONDON. About 1855. A private house in a country road. EFFECTS (1) Ground-floor. *Grate* struck in one room, and in another a box of clothes near a grate destroyed, and *gaselier* damaged. (2) First floor. *Grate* struck. (3) Second floor. *Grate struck.* (4) *Chimney-pot* above struck. [L.R.C., 39, and letter from Mr. Wyatt Papworth, F.R.I.B.A.]

(484) NEAR SHEFFIELD. (No date given). A detached private house. An *iron eaves-gutter* 20 feet below top of *chimney.* EFFECTS.—Top of chimney, 52 feet 6 inches above ground, deranged. [L.R.C., 40. Mr. J. B. M. WITHERS, F.R.I.B.A.]

(485) WIBSEY, NEAR BRADFORD. 1858. School-house. Inside house and hanging from roof was an *iron rod* of small diameter. EFFECTS.—One boy killed and 8 others injured. [L.R.C., 46. Mr. G. J. Symons, F.R.S.]

(488) ST. PETER'S CHURCH, BRIGHTON. August 18th, 1858. With tower and pinnacles. A *lightning-rod* carried up one pinnacle. EFFECTS.—One of the other pinnacles struck, the distance between being scarce 10 feet. [L.R.C., 48. Mr. G. J. Symons, F.R.S.]

(490) MAIRIE OF 20TH ARRONDISSEMENT, PARIS. About 1874. During construction. Some pieces of *iron framing* lying on ground close to scaffolding. To a pole of latter a *chain* was attached. EFFECTS.—Rust taken off chain. A firpole of scaffolding struck, but not damaged. [L.R.C., 69. M. Francisque, Michel.]

(492) MONTE VIDEO. About 1822. House of British Consul. Had a flat roof with a flagstaff. A copper *bell wire* near cornice of ceiling below roof. EFFECTS.—Wire melted into globules. Slight damage at *bell.* Roof pierced. Flagstaff shattered. [L.R.C., 45. Admiral B. J. Sullivan.]

(499) FOREST HALL, NEAR NEWCASTLE-ON-TYNE. August 10th, 1883. A two-storied villa with 5 gables. Built of masonry. A chimney stack at each gable. Fitted with 5 *copper lightning-rods,* one at each *chimney stack. Iron eaves-gutters* and *rainwater down pipes.* Rods connected to each other, and proceeded to earth alongside two rainwater pipes. EFFECTS.—The east and lowest of the 5 terminals was broken off, and thrown into adjoining eaves gutter. [Examined by the writer on August 29th, 1883.]

(500) BENTON VIEW, NEAR NEWCASTLE-ON-TYNE. August 10th, 1883. One of a row of four low two-storied buildings built of rubble, with slated roofs. No basement. EFFECTS.—(1) *Ground floor.* In front room *bell wires* broken and chimney breast damaged. In kitchen at back *bell wires* broken, and inner corner of kitchen wall near range blackened. (2) *First floor.* In front room the *grate* was lifted bodily into the room. White marble mantelpiece shattered to pieces. *Bell wire* broken. In back room close to bell wire a hole burnt in floor cloth, and small hole pierced in floor. Bell wire broken, and plaster torn off around handle. (3) *Chimney* over centre of ridge shattered. [Examined by the writer on August 29th, 1883.]

(501) WADSLEY BRIDGE, NEAR SHEFFIELD. July, 1883. *Boiler chimney,* with *iron lightning-rod.* EFFECTS.—Rod "shattered to pieces" at the joints. [Newc. D. C., 30/8/83.]

(503) OLDHAM, LANCASHIRE. August 31st, 1883. *Boiler chimney* with *lightning-rod.* EFFECTS.—Several pounds' worth of window glass broken. Loose material in mill set on fire. Discharge passed between mill and rod, latter being struck. [Manch. Exam., 1/9/83.]

(504) A VILLAGE IN SUSSEX. 1880. A cottage. EFFECTS.—Plaster of wall rent, and a *penknife* brought to view, supposed to have been left there by the plasterer. [Letter from Canon Curteis, M.A. 18/8/83.]

(506) HOUSES OF PARLIAMENT. June, 1868. Victoria Tower. Fitted with copper *lightning-rod.* EFFECTS.—"A fearful shock" felt. Building slightly damaged. [Tel. Journ., 1/10/80. Mr. R. Anderson. Gray & Son. Circ. (1883). Builder, 6/6/68.]

(507) ASHURST, NEAR STEYNING, SUSSEX. July 1883. Church with low stone tower and timber spire, surmounted with *lead capping* and an *iron vane* fixed to apex of rafters. In belfry 5 *bells.* EFFECTS.—One oak rafter splintered down middle. An adjacent one broken to pieces. Roof burst out at sides close to two last rafters. [Letter to writer from Mr. Wyatt Papworth, F.R.I.B.A., 12/9/83.]

(510) DEPAUVILLE, JEFFERSON CO., N.Y., U.S.A. April 20th, 1867. Private house. On ground floor was a cooking *stove* resting on wooden blocks. EFFECTS.—Blocks knocked from under legs of stove. Latter not upset. A number of "lights" broken. [Report of Smiths. Institution, 1867, 319. Mr. H. Haas.]

(512) MANHATTAN, Kansas, U.S.A. June 15th, 1867. Private house. Fitted with an iron *lightning-rod,* screwed together with *brass nuts.* Point of *silver-plated copper. Tin eaves-gutter* round house. EFFECTS.—At each of 8 rectangular corners of gutter tin was burnt or melted. Rod severed at every joint and nuts in some cases melted. Point melted for ½ inch. [Rep. Smiths. Instn., 1867, 320. Professor F. Mudge of Manhattan.]

(513) NEWHAVEN, CONNECT., U.S.A. June 20th, 1867. House with *roof covered with tin. Rain-water down pipe* running to ground. EFFECTS.—(1) *Ground floor.* A pail with *copper hoops* standing near a sink "completely demolished." An earthen tile drain shattered. (2) *Room under attic.* Lath and plaster torn off a closet. Under pillow of bed was found a *nail* that was so hot when thrown there that it had burnt the sheets. (3) *Attic.* Two holes through a windowpane. Ceiling splintered into a thousand fragments. Floor pierced at a corner near *rain-water pipe.* (4) *Roof.* Stroke passed through roof near a *chimney,* "tearing up the tin roofing as if it "had been forced off from the inside." Another

chimney struck and partly knocked down. [Rep. Smiths. Instn., 1867, 320. (Newhaven Journal.)]

(517) CRABTREE ROW, SHOREDITCH, LONDON. July 17th, 1787. Shop. EFFECTS.—(1) Ground floor. Frame of a sash-window split at *hinges.* (2) First floor. *Lead* of shop windows melted in many places. (3) Tiles of roof broken in several places. [Mem. Med. Soc. of London, II. 494. (1794.) Mr. J. Parkinson of Hoxton, Surgeon and F.M.S.]

(527) ST. BOTOLPH'S CHURCH, BOSTON. July, 1865. Lofty tower with 8 pinnacles. EFFECTS.—Glass fused in one of upper windows of tower. Several pieces of stone shaken off tower. Stonework at base of a *spindle of a vane* on one pinnacle damaged. [Build., 22/7/65.]

(528) COLCHESTER. July, 1865. Roman Catholic Church, with ornamental turrets over west entrance. On top of one turret was a *small copper cross* fixed in a stone ball. *Organ* gallery adjacent with a *lead gas pipe* close by. EFFECTS.—(1) Gas pipe melted. Organ gallery struck. A large hole made in brickwork of inside wall. (2) Turret with cross demolished. Build., 22/7/65.]

(530) SUTHERLAND STREET, PIMLICO. July 29th, 1860. Two houses, 4 storeys high. In the brickwork "*hoop-iron bond* was used throughout." EFFECTS.—Struck at 6 P.M. "The houses shaken to "the foundation." About 11 P.M. the front walls fell inwards, dragging with them the back walls, and the houses became a heap of ruins. [Build., 4/8/60.]

(532) EDINBURGH ASSEMBLY HALL. April 30th, 1851. Windows on south face of church had *zinc astragals. Gas-pipes* near window. EFFECTS.—A number of oak benches set on fire. Woodwork inside a window with zinc astragals ignited. Window pierced. [Build., 10/5/51.]

(533) KING'S CROSS CHURCH, HALIFAX, YORKSHIRE. (About 1846.) In course of erection. Lower end of *lightning-rod* was 20 feet from the ground, being then incomplete. EFFECTS.—Ground rent at a short distance from rod and rod struck. [Build., 17/5/51. Mr. R. D. Chantrell.]

(534) BROMPTON CRESCENT, LONDON. May 17th, 1856. Private house. *Bell trap* in ground close to front of house. *Copper bell wire* with *brass cranks* between front wall of house and garden gate enclosed in a *zinc tube.* EFFECTS.—Bell trap struck. Zinc tube struck. Wire fused at cranks both outside and inside house. [Build., 31/5/56.]

(535) ST. JUDE'S PARSONAGE, SOUTHSEA. June, 1856. At a distance of 100 feet from *chimney* was spire of St. Jude's Church 150 feet high, provided with a copper *lightning-rod.* EFFECTS.—Slating of roof of parsonage shivered and chimney struck. [Build., 19/7/56.]

NOTE.—Height of chimney above ground not given.

(539) WIGTON RAILWAY STATION. August, 1867. Had *telegraph wires* and *lead gas pipes.* EFFECTS.—Pipes melted and gas ignited. [Build., 14/9/65.]

(541) PARISH CHURCH OF ST. PÉ-ST. SIMON, FRANCE. August, 1867. With *clock* tower containing *bells.* EFFECTS.—(1) The stroke "rent the "foundations" and "tore up the flooring." [Build., 14/9/65.]

(542) PARISH CHURCH AT SAUZET, LOT, FRANCE. August, 1867. With belfry and *bells.* EFFECTS.—Timber of belfry set on fire. A woman ringing the bells killed. [Build., 14/9/65.]

(548) HETHERSETT CHURCH. May, 1871. With tower, *bells,* and *vane.* EFFECTS.—Some stone tracery of church windows damaged. Belfry walls injured. Point of vane struck. [Build., 10/6/71.]

(549) ST. JOHN'S CHURCH, BURY ST. EDMUND'S. May, 1871. Brick spire 160 feet high, with a copper *lightning-rod.* EFFECTS.—About 2-5ths. down spire rod was "completely severed." It was also displaced at the top. In neighbourhood of severance a shock given to brickwork and stone quoins, some of the joints of which were opened not less than 1 inch. [Build., 10/6/71.]

(552) BAMPTON. May, 1872. Parish Church. Spire 180 feet high with 5 *iron clamps, clock* and *bells.* EFFECTS. — *Wires* connecting chimes with clock "destroyed." On north side of spire 10 courses of stonework displaced. Spire split on south side [Build., 18/5/72.]

(554) HALIFAX, YORKSHIRE. June, 1872. Cattle shed with *iron pillars.* EFFECTS.—A man close to a pillar killed. Beam overhead split. Part of roof fell in. [Build., 29/6/72.]

(557) FORRES, N.B. August, 1872. Chemical works. EFFECTS.—Chamber of *thick sheet lead,* containing 70 tons of sulphuric acid "destroyed." [Build., 17/8/72.]

(559) FURZE HILL, BRIGHTON. June, 1868. School. A detached building. Two *chimney stacks* on western side a few feet apart. On one was a *lightning-rod.* Chimneys surmounted with long and heavy *zinc pots.* EFFECTS.—(1) In drawing-room the stroke "put the *fender* on one side, and threw the *fire-"irons* on the floor." (2) In a room above it "tore "out a register *stove,* and displaced a mantelpiece." (3) At roof it "tore off the slates in two places," and carried away 4 zinc flues from the chimney stack not fitted with a rod. [Build., 6/6/68.]

(565) CROMER, NORFOLK. April, 1873. Parish church. (1st time.) With a tower and *copper lightning-rod* thereon. EFFECTS.—(1) Earth torn up round tower for 20 yards. At a point in wall of tower 3 feet above the ground, where a *spike* was driven to secure rod to wall, the latter—4 feet in thickness—was pierced, and damage done inside tower. [Build., 26/4/73.]

(566) MARTHAM, NORFOLK. April, 1873. Parish church, with tower, *clock, bells, vane, eaves-gutters,* and *down pipes* leading to drains. EFFECTS. — (1) At the feet of the down pipes the earth was torn up for some distance. Each of these pipes and the eaves-gutters were struck. (2) Dial-plate of clock wrenched off. Wooden casing of clock burst open. (3) Roof of tower pierced, parapet walls shattered, and stones thrown far away. Vane and an *iron stay* securing it struck. [Build., 26/4/73.]

(567) RIPPONDEN CHURCH. October, 1873. With spire and *lightning-rod.* EFFECTS.—(1) Melted lead portion of *gas piping* in tower, ignited gas at meter, and set woodwork on fire. (2) One of *clock weights* broken in two, and *wire rope* suspending them severed. Gearing of *chiming apparatus* damaged. [Build. 1/11/73.]

(571) DURHAM. April 13th, 1875. Private house. EFFECTS.— (1) *Water pipes* in middle of adjacent street burst. Several *gas pipes* on each side of the way burst. (2) *Chain* of cellar *grate* broken. (3) A strong *cast iron rainwater pipe* leading to earth broken, and *eaves-gutter* above struck. (4) *Chimney stack* "demolished." [Build. 17/4/75.]

(575) CLAYPONDS, NEAR KEW BRIDGE, MIDDLESEX. August 19th, 1876. Private house. Fitted with a copper *lightning-rod* leading into dry earth. EFFECTS. — (1) Rod struck, the "stroke "causing the greatest disturbance all along its path, "lifting up, among others, some heavy marble toilet "tables in bedrooms some 6 feet distant on each side "from the copper rope." (2) Part of coping of large *chimney* not more than 2 or 3 feet from rod was knocked off. [Build. 14/9/78. Mr. R. Anderson.]

(579) ST. SAVIOUR'S CHURCH, SOUTHWARK. July 27th, 1870. (2nd time.) With tower and pinnacles. On S.E. pinnacle (150 feet above ground) a *copper ball and vane.* On tower was an *eaves-gutter* joining an *iron downpipe* leading to earth. EFFECTS. — (1) Downpipe and eaves-gutter struck. (2) S.E. pinnacle totally destroyed, and stones thrown far away. Build. 30/7/70.]

(581) SOUTH WOOTTON, NORFOLK. September, 1881. Parish church. EFFECTS. — Roof pierced at *lead ridge.* Tower split almost in two. [Build. 1/10/81.]

(588) BREMEN. August, 1771. Church of St. Anscharie. (1st time.) With tower and spire, 335 feet high. Spire had a *copper covering* for a depth of 133 feet, and was surmounted by a *cross.* A copper *lightning-rod* descended from covering on to the surface of ground. EFFECTS.—Rod struck. [Duprez 32.]

(590) NEW CAMBRIDGE, U.S.A. About 1773. Harvard Hall. Had iron *lightning-rod.* EFFECTS.—Rod struck, slight traces left on wall at joints of rod. [Duprez 33.]

(592) ALTICHIERA, NEAR PADUA. August 17th, 1774. Country house of Signor Querini. Had iron *lightning-rod.* EFFECTS.—Rod struck. [Duprez 33.]

(595) CENEDA, ITALY. Before 1778. A country house. Fitted with an iron *lightning-rod.* EFFECTS. —Rod struck and point melted. [Duprez 34.]

(597) SEEFELD, NEAR MUNICH. August 2nd, 1781. Castle of Count Torring, with an iron *lightning-rod.* EFFECTS. — The ground around the bottom of the rod, which was sunk 13 feet, was raised with great force, and the rod struck. [Duprez 35.]

(598) BUTZOW, MECKLENBURG. August 25th, 1782. A thatch-roof barn with 2 *iron lightning-rods.* EFFECTS.—One of rods struck, part of solder at base melted, and paint on stalk raised in places. [Duprez 36.]

(599) BREMEN. August 3rd, 1783. Church of St. Rembert. Bell tower covered with *copper* and fitted with copper *lightning-rod.* EFFECTS.—Ground raised at foot of rod, and point greatly heated. [Duprez 38.]

(600) DORTMUND, WESTPHALIA. September 23rd, 1785. (2nd time.) Church of St. Regnauld. Had a tower containing *bells,* surmounted by a pointed *copper star,* and fitted with an iron *lightning-rod.* Roof of nave covered with *lead.* EFFECTS.—Adjacent to bells the rod was bent so as to deviate 12 inches from its vertical direction. [Duprez 37.]

(602) CARTHAGENA. September, 1787. Powder magazine, with *lightning-rod.* EFFECTS.—Rod damaged in certain places and point melted for a length of about 6½ inches. [Duprez 37.]

(603) DOCKENHUDN, GERMANY. June, 1788. A country house, with *leaden roof* and a copper *lightning-rod.* EFFECTS.—On each side of foot of rod the flagged pavement was raised for a distance of 6 to 9 feet. Point of rod bent. [Duprez 37.]

(604) ISLE OF AMAK, COPENHAGEN. July, 1788. Powder magazine with iron *lightning-rod.* EFFECTS.—Upper six inches of rod bent horizontally, and point rendered quite brittle. [Duprez 38.]

(605) DORTMUND, WESTPHALIA. February 16th, 1789. Church of St. Regnauld. (3rd time.) Choir turret. Had a *leaden roof* surmounted by a *brass ball, copper cross,* and *weathercock.* Roof laterally supported by 4 *iron bars.* Fitted with an iron *lightning-rod.* EFFECTS.—The brass ball (about 9 inches wide and 4 inches high) was so split that its pieces would hardly hold together. [Duprez 38.]

(606) OPPENWEILER, NEAR HEILBRONN. June 21st, 1789. House with turret surmounted by a *copper ball* and fitted with an iron *lightning-rod. Eaves-gutters* and other metals of house connected to rod. EFFECTS.—A piece of *lead* interposed in rod at base of upper terminal melted. At point a length of about 3 inches was melted. Upper extremity was also bent from its vertical direction. [Duprez 39.]

(607) ROSTOCK, MECKLENBURG. July 9th, 1790. Church of St. Pierre. Tower, 357 feet high, had *top covered* with *copper,* and was provided with a copper *lightning-rod,* ending in a well. EFFECTS.—At the top of the well two laths of the wood casing of the rod was raised. At a distance of 11 feet 8 inches the small window of an adjacent house had its panes thrown into the middle of the house. [Duprez 39.]

(608) NERESHEIM, WURTEMBURG. June 7th, 1791. Church fitted with an iron *lightning-rod* having three upper terminals. EFFECTS.—The *lead* at the base of each of these terminals was melted, and each of the points was melted for a length of nearly 1⅜ inches. [Duprez 39.]

(612) KILKBERG. May 28th, 1819. Factory with an iron *lightning-rod.* EFFECTS.—Rod struck. [Duprez 40.]

(615) DOESBURG, HOLLAND. January 14th, 1882. Church with *bell* tower. Iron *lightning-rod* attached. EFFECTS.—Rod struck. [Duprez 40.]

(618) WETHERSFIELD, CONN., U.S.A. 1826. A private house. With an iron *lightning-rod.* EFFECTS.—A hole made in the ground near rod, and rod struck. [Duprez 41.]

(619) LUXEMBOURG. July, 1829. Powder magazine "du Saint Esprit." An iron *lightning-rod* with three upper terminals. EFFECTS.—At a screw joint the rod was raised (soulevé). [Duprez 41.]

(620) GENOA. Summer, 1831. Tour du Puin. An *iron lightning-rod* leading into a cistern of water. EFFECTS.—Rod broken and partly melted. [Duprez 43.]

(656) CHERBOURG. July 11th, 1852. Powder magazine "du Nord." With *lightning-rods.* EFFECTS.—Rods struck 8 times. [Duprez 49.]

(657) CHERBOURG. July 11th, 1852. Powder magazine of the Fort des Flamands. Had a *lightning-rod,* with copper upper terminals. EFFECTS.—Pin retaining platinum point to rod torn out and point thrown down. [Duprez, 49.]

(666) VILLERS-LA-GARENNE, NEAR PARIS. August 17th, 1792. House, with an *iron lightning-rod* surmounted by two terminals. At base of rod was a gap of 6½ inches. EFFECTS.—On first floor flask on mantelpiece shivered. In this room was an *iron bed-*

stead. Interior of house near top of rod and *eaves-gutter* damaged. [Duprez, 52.]

(668) THE MINT, PARIS. July 13th, 1807. House with an iron *lightning-rod.* Portion of it badly joined, and end not sunk in the water of the well intended for it. EFFECTS.—Every object inside the house was shaken. *Chimney* near which rod was fixed damaged. Point of rod melted. [Dupr. 52.]

(669) DUSSELDORF. January 11th, 1815. Tower of St. Lambert. With an iron *lightning-rod.* EFFECTS. Point of rod melted, and building set on fire. [Dupr. 53.]

(670) BERNE. May 14th, 1820. A private house, an iron *lightning-rod* fixed to a wooden pole near two *chimneys.* EFFECTS.—(1) All inhabited parts of house filled with a dazzling light, and 3 persons knocked down senseless. (2) The ground raised round the foot of the rod. (3) Traces of red heat left on the lower part of rod, and at base of upper terminal. (4) Chimney nearest rod and adjacent roof greatly damaged. [Dupr. 53.]

(672) SÉMUR, COTE D'OR, FRANCE. June 16th, 1835. Church with a *lightning-rod.* EFFECTS. Rod struck and the church greatly injured by the stroke. ("Le paratonerre ne préserva pas l'édifice des ravages de la foudre.") [Dupr. 55.]

(677) DRESDEN CASTLE. August 24th, 1783. Had a tower 318 ft. high, with an iron *lightning-rod* leading into running water. *Tower roof covered with copper* connected to rod. On one portion of the castle was a balcony with an *iron balustrade,* and with its foot *covered with copper.* EFFECTS.—Balcony and rod struck. [Dupr. 61.]

(678) HOLSTEIN. July 21st, 1792. House on the Alster, with two *chimney stacks* not more than 12 feet apart, along each of which were *leaden plates* connected to hips of roof. To one of the stacks was fixed a copper *lightning-rod.* EFFECTS.—One of lead plates at base of chimney to which no rod was fixed was raised over an extent of 1 ft. 8 in. [Dupr. 61.]

(680) KOPPINGEN, SWITZERLAND. June 5th, 1819. Wooden house. Provided with an iron *lightning-rod* having two upper terminals with *brass points,* and leading into moist earth. EFFECTS.—House set on fire and destroyed. [Dupr. 62.]

(688) ST. AUBIN, LORRAINE. Dec. 14th, 1755. Church. With steeple, *clock* and *bells.* EFFECTS. —(1) Walls of church cracked and shaken. (2) Timbers in steeple supporting great bell broken down. South and west angles of steeple thrown down, and stones hurled to a great distance. [Gent. Mag. XXV., 42.]

(689) MARYLAND, N.A. April, 1755. Large brick house with 2 *chimneys* at each end (N. & S.) and cupola in middle having an iron *weathercock* about 12 feet higher than chimney tops. EFFECTS.—(1) At 5 inches above ground a hole pierced through floor. (2) Bedroom above. Wainscot split near a *looking glass* and an *iron curtain rod.* (3) Room above. Some *tin* near top of a large looking glass melted. (4) Room above under roof. A fir rafter splintered. [Gent. Mag. XXVI., 32.]

(691) CHRIST CHURCH, DUBLIN. Nov. 3rd, 1757. EFFECTS.—One pinnacle thrown down, and on steeple the great *ball* and *ironwork about weathercock* lately *gilded,* were turned quite black. [Gent. Mag. XXVII., 527.]

(693) LANREATH, CORNWALL. June 21st, 1756. Pelyne Farmhouse. EFFECTS.—(1) Room on ground floor. A table overturned. A man much burnt. *Chimney* flue struck. (2) Upper room. A *copper skillet,* pair of *sheep shears,* and some old *brass buckles* and *candlesticks* were melted. Roof pierced. Chimney cracked from slating of roof to top. [Gent. Mag. XXVIII., 358 (Phil. Trans. L., 1757).]

(697) CLARE CHURCH, SUFFOLK. February 3rd, 1764. EFFECTS.—Part of tower, *dial of clock,* and *chimes* thrown down. [Gent. Mag. XXXIV., 94.]

(702) LONGHAUGHSHIELD, NEAR NEWCASTLE-ON-TYNE. April 10th, 1774. A cottage. EFFECTS.—(1) "The ground round the house was "furrowed up." (2) Man and wife sitting by fireside killed. (3) Cottage set on fire and reduced to ashes. [Gent. Mag. XLIV., 187.]

(704) BUCKLAWREN. June 26th, 1756. Near Looe, Cornwall. Farmhouse. EFFECTS.—(1) *Ground floor.* (a) In kitchen "stroke threw the plates, *pots,* "*and kettles* about the room." (b) In parlour mouldings torn from wainscot, and a small stock *lock* ripped off door. (2) *Bedroom above parlour. Chimney-piece* broken into many parts. Window torn to pieces. Bed set on fire. Large breach made in ceiling and in floor above. (3) *Garret.* Stones and mortar torn out of wall. A large breach made through roof. [Gent. Mag. XXVIII., 157 (Phil. Trans. L., 1757).]

(708) DISLEY, NEAR STOCKPORT, CHESHIRE. May 7th, 1776. Private house. EFFECTS.—In lower rooms many utensils both *brass and iron* melted. Roof broken through. [Gent. Mag. XLVI., 236.]

(714) ABBOT'S RIPTON, HUNTINGDONSHIRE. July, 1783. Rectory. EFFECTS.—Lady sitting close to a small *bell wire* killed. [Gent. Mag. LIII., 621.]

(717) IDDLESLEIGH MILLS, NEAR EXETER. July, 1783. Millstones had *iron axles.* EFFECTS.— "The millstones were shattered," but the iron axles uninjured. Mills set on fire. Two men thrown senseless. [Gent. Mag. XLVI., 383.]

(720) HINCKLEY. June 16th, 1783. Two houses. EFFECTS.—Windows shivered, and *lead* on them melted. Seven persons injured. "The roof in a great "measure untiled." *Chimney* "entirely demolished." [Gent. Mag. XLVI., 531.]

(722) WHITECHURCH, HANTS. July 21st, 1783. "White Hart" Inn. EFFECTS.—Kitchen *chimney piece* "shivered to atoms," and house much damaged. Four persons injured. [Gent. Mag. XLVI., 708.]

(731) NORWICH. August 9th, 1787. House of a cooper. EFFECTS.—On a lower floor the stroke "split "a door, and threw it off the *hinges.*" Wall of a room above rent at point where was an *iron holdfast.* Latter forced out.—Gent. Mag. LVII., 823.]

(732) FINNISTOWN, GLASGOW. August 9th, 1787. Private house. EFFECTS.—(1) Lower room. A dog with an *iron collar* round his neck struck senseless. Ceiling pierced. (2) Garret above. Woodwork of bed shattered. (3) *Chimney* thrown down. [Gent. Mag. LVII., 823.]

(734) CRANBROOK, KENT. August 19th, 1787. Parish church. With steeple, *clock, chimes, spindle,* and *vane.* EFFECTS.—(1) Roof of chancel struck. (2) Many *gilded hour figures* on dial of clock effaced. Holes pierced in door of chime loft. (3) Timber through which *iron vane spindle* passed split into

several pieces, and thrown to a great distance. [Gent. Mag. LVII., 823.]

(735) CUPAR, N.B. September 25th, 1787. Old House of Correction. Used as a carpenter's shop. *Iron hoops* on floor. A *wire birdcage* suspended from a joist. EFFECTS.—(1) Ground floor. Two men sitting on a bench below birdcage killed. Birdcage torn to pieces. Floor above perforated at side of joist whence hung cage. Many pieces of men's clothes found several yards distant, and small pieces from their hats had penetrated the door and stuck in it. Part of a foot rule belonging to one of the men was found a few steps up the stairs. (2) A number of slates torn from roof. [Gent. Mag. LVII., 926. Letter from Cupar, 27/9/87.]

(736) HINCKLEY. August 16th, 1791. High Cross. A monument, with stones connected by *iron cramps*. EFFECTS.—"Many of the stones split by the "lightning, and thrown about." Upper part thrown down. [Gent. Mag. LXI., 691. Mr. J. Robinson.]

(739) RAINHAM CHURCH, KENT. October, 1791. With a tower. EFFECTS.—(1) Door of vault outside east window was forced off its *hinges* and east window pierced. (2) West door forced out; stone steps in church tower shivered. (3) Wall of tower cracked. [Gent. Mag. LXI., 1056.]

(740) CASTOR, NEAR BIRMINGHAM. June 4th, 1795. Parish church. With tower, spire, *clock*, *bells*, iron *spindle*, and vane. Roofs covered with *lead*. At *eaves* were *lead spouts*. EFFECTS.—(1) Windows under ends of lead spouts pierced, and the stones thrown to a great distance. (2) Wire connecting hour wheel with clock hammer melted. *Lock* on clock case door forced off. *Staple* of a smaller door forced off, and door thrown down. (3) Wall pierced below window near clock bell. Masonry at vertex of spire split. Vane struck. [Gent. Mag. LXV., 517.]

(742) WELLS, NORFOLK. June 28th, 1797. A cottage. One storeyed, and surrounded by loftier buildings. EFFECTS. — (1) Stroke pierced brick-work over window and melted some of the *lead* on it. (2) *Chimney* stack above roof twisted round. [Gent. Mag. LXVII., 551. Mr. John Hill.]

(744) CALDECOT CHURCH, RUTLANDSHIRE. July 30th, 1797. With spire, *bells*, *spindle*, and *weathercock*. *Iron stanchions* in north windows. Roof of nave covered with *lead*. EFFECTS.—(1) North wall of nave cracked perpendicularly down middle lights and between windows. (2) Opposite windows in south aisle much shattered. (3) Over door of steeple in churchyard arch mouldings shattered. (4) Below middle bell window a piece chipped off. A little below uppermost bell window a large hole made and a stone shivered. Upper part of spire with spindle and vane carried off altogether. [Gent. Mag. LXVII., 817.]

(745) GRANTHAM CHURCH. July 30th, 1797. With steeple and clock. EFFECTS.—(1) Locked doors at west end thrown open. (2) *Wires of clock* struck. (3) Two or three stone knobs of steeple broken off. [Gent. Mag. LXVIII., 104.]

(756) ATTERCLIFFE CHAPEL, NEAR SHEFFIELD. July 1st, 1810. With a *belfry*. EFFECTS.—Commandment board split. N.E. window of gallery burst to pieces, and frame driven out. Several windows shattered and stones dislocated. Belfry struck. Roof torn. [Gent. Mag. LXXX., 79.]

(763) LISANALLY, OMAGH, IRELAND. Aug. 2nd, 1819. Private house. EFFECTS.—(1) In parlour a man leaning against wall was killed. (2) In several other rooms *bell wires* broken, marble chimney pieces shattered, and much glass smashed. (3) *Chimney* struck at a point near a large number of *iron cranks*. [Gent. Mag. LXXXIX., 188.]

(764) TUTTEL STREET, NEAR LIQUORPOND STREET, LONDON. July 30th, 1820. Houses Nos. 12 and 13. EFFECTS.—(1) Ground floor. *Lock* and *hinges* of door wrenched off. Woodwork set on fire. (2) First floor. Some clothes set on fire. *Bell wire* and *cranks* destroyed. (3) Roof pierced. *Chimney* pots shivered. [Gent. Mag. XC., 176.]

(765) REDCLIFFE TOWER, BRISTOL. April 2nd, 1821. Tower with *bells*. EFFECTS.—(1) *Bell wires* heated. (2) At south side near an adjacent roof a hole pierced in wall, the stroke "rolling up the *lead* from "the roof." (3) Beam supporting one of bells shattered. A large aperture made at upper bell-loft window, and the stones thrown to a great distance. [Gent. Mag. XCI., 367.]

(768) NORTH LUFFENHAM CHURCH, RUTLANDSHIRE. June 10th, 1822. With spire, *clock*, *bells*, *iron spindle*, and *vane*. EFFECTS.—(1) Lower windows near gable shattered. Walls pierced in several places. (2) A part of steeple wall on N.E. side forced out. (3) Upwards of 10 feet carried off top of spire, and thrown to a great distance. [Gent. Mag. XCII., 636.]

(769) RAUNDS CHURCH, NORTHAMPTONSHIRE. July 31st, 1826. With spire; *iron bars* on windows. EFFECTS.—(1) Almost all the windows had peculiar rents. (2) Two large holes made in side of spire, and "several yards" of it were thrown down. [Gent. Mag. XCVI., 362.]

(771) EDLESBOROUGH CHURCH, BUCKINGHAMSHIRE. April, 1828. Wood steeple covered with *lead*. Had *bells*. EFFECTS.—Steeple set on fire; molten lead poured down. All the bells except one fell red hot. [Gent. Mag. XCVIII., 358.]

(778) ORMSKIRK. June 1st, 1767. House in Church-street. EFFECTS. — *Lead* of lower windows melted. Side of house shattered. Windows in 3rd story broken away. Slates thrown from roof. *Chimneys* carried away. [An. Reg. 97.]

(779) MAYENCE CATHEDRAL. May, 1767. Roof pierced and set on fire. *Bells* melted. [An. Reg. 93.]

(783) PITCULLO HOUSE, SCOTLAND. August 3rd, 1769. EFFECTS. — *Looking glasses* throughout house shivered. A woman burnt. [An. Reg. 121.]

(794) PLYMOUTH. Some years before 1883. A church with spire 180 feet high; newly built; copper *lightning-rod* in course of fixing. About 80 feet had been fixed, and remainder of rod (wire rope) was coiled up on scaffold. EFFECTS.—Rod struck. Top of spire seriously damaged. [Journ. C. W. Assoc., 1/10/83. Mr. E. Moore.]

(798) OXFORD. June 1st, 1780. House and shop in St. Clement's. EFFECTS. — (1) Ground floor. In kitchen, wooden frame round *fireplace* torn away, "*candlesticks*, *flat-irons*, &c., scattered about," and other metal articles partially melted. (2) First floor. *Chimney* piece destroyed. Casement of window forced outwards. (3) At upper room, partition of staircase shivered. (4) *Chimney* struck. [An. Reg. 217.]

(799) THE BOROUGH, LONDON. June 18th, 1782. A private house. EFFECTS.—(1) Stroke lifted the door of an upper room off the *hinges*, and removed it a great distance. It "twisted the *ironwork of a case*-"*ment*" in several shapes. (2) Roof forced down. *Chimney* stack split up its whole length. [An. Reg. 210.]

(804) ASHTON-UNDER-LYNE CHURCH. January 28th, 1791. Steeple with *belfry, clock, vane*, and *iron ornamental work*. EFFECTS.—(1) Floor of *organ* gallery, with vertical *curtain rods* in front, pierced over an *iron column* supporting it. An "*up*-"*right iron*" reaching from ceiling to gallery was "rent," and splinters were found sticking in the ceiling as if discharged by a gun. (2) A clock dial—with iron rod guiding hands—over top of organ struck. Wires in belfry and also those of clock melted. (3) Many stones thrown from steeple. Part of vane melted. [An. Reg. 3.]

(805) ACOMB, NEAR YORK. April 12th, 1792. Private house. EFFECTS. — (1) Ground floor. *Bell wire* struck. *Gilding* of several picture frames blackened. (2) *Chimney* struck. [An. Reg. 15.]

(806) PORTSMOUTH. May 20th, 1792. "Star "and Garter" Tavern. EFFECTS.—*Lamp iron* near coffee room struck. One of beams of 2nd floor split for several feet. Stroke "forced its way upwards "through the roof, which was considerably damaged "by it." [An. Reg. 19.]

(808) ROLLS YARD, CHANCERY LANE, LONDON. August 17th, 1794. Examiner's office. *Iron weathercock* on roof. EFFECTS.—A large hole torn in roof. Many bricks and tiles shattered. Adjoining house set on fire. *Nails* and *ironwork* melted. [An. Reg. 22.]

(809) BRAINTREE CHURCH, ESSEX. August 14th, 1759. With steeple and *clock*. EFFECTS.—Clockwork melted. Steeple "shivered into a hundred "pieces." [An. Reg. 30.]

(810) FIELDALLING, NORFOLK. August 14th, 1795. Cottage. EFFECTS.—A "*hake*" and a *tea kettle* over *kitchen fire* melted. A woman in kitchen, with a *looking-glass* on her lap, struck blind, and a man thrown senseless. *Chimney* split. [An. Reg. 31.]

(816) BRUTON STREET, LONDON. June 7th, 1803. House of Sir F. Whitworth. EFFECTS.—A great coat hung in kitchen entirely consumed. Wainscot burnt. All the *leaden pipes* melted. Wire of *door bell* "completely destroyed." [An. Reg. 396.]

(818) OLMUTZ CATHEDRAL. April 13th, 1803. With 4 towers and *bells*. EFFECTS.—One of the towers struck, and set on fire. [An. Reg. 383.]

(820) EDENHAM CHURCH, LINCOLN. June 13th, 1804. With tower, pinnacles, and *clock*. EFFECTS.—Clock dial broken. Clockwire struck. One of pinnacles broken off. [An. Reg. 394.]

(826) DERITEND, NEAR BIRMINGHAM. July 30th, 1805. A timber shed. With *weathercock*.—EFFECTS.—(1) A man in sawpit struck on foot, and thrown out of the pit senseless. (2) *Lead* of an open casement melted. A rafter split. Letter N cut away from under weathercock. [An. Reg. 408.]

(835) SUTTON PLACE, GUILDFORD, SURREY. July 11th, 1806. EFFECTS.—(1) Ground floor. At a window with *upright iron bars* glass was broken. (2) Bedroom above. *Wire* of one of *bell pulls* melted. A *small iron back* at *chimney* displaced. (3) Bricks forced out on one side of *chimney stack*, and a chimney pot split. An. Reg. 425.]

(844) BERWICK. November, 1808. Building with cupola and *clock*. EFFECTS.—Two windows broken. Under cupola 10 holes made in slated roof and 6 in the wall. [An. Reg. 123.]

(845) SOUTH PARK, HEDDON, YORKSHIRE. Private house. EFFECTS.—In parlour a man sitting with his head close to *bell handle* struck dead. [An. Reg. 89.]

(851) GREENWICH CHURCH. May 6th, 1813. Steeple with *weathercock*. EFFECTS.—Part of steeple with weathercock thrown down. [An. Reg. 38.]

(857) ST. MARTIN'S CHURCH, GUERNSEY. January 23rd, 1819. With tower, *belfry*, pinnacles, and *vane*. EFFECTS.—(1) Seats "torn up." Several pillars received large cracks. All windows broken. East window thrown into churchyard. (2) A *bell wire* from near pulpit to belfry struck. Weathercock on pinnacle and stone on which it was fixed thrown down. [An. Reg. 5.]

(860) ALPHINGTON CHURCH, NEAR EXETER. March 1828. Tower with pinnacles, *bells*, and *weather-cock*. *Lead roof* with *spouts*. EFFECTS.—(1) A person standing in doorway of tower, with an iron hammer in his hand, killed. Another man "hurled many "yards into the church." (2) The stroke "tore up "the stairs of the tower." Whole building shattered. Tower wall rent vertically. (3) Bells ungeared and injured. Vane much distorted. [An. R. 96. L.R.C., 37. Mr. J. Jerman, A.R.I.B.A.]

(863) MILE END NEW TOWN, LONDON. May 23rd, 1830. Two houses. EFFECTS.—(1) *chimney flue* in a room struck. A person in same room killed. (2) At adjacent house sash frames rent from sockets; "the *melted lead* ran down the walls." Brickwork rent, and roof pierced. [An. Reg. 80.]

(869) ROODEN LANE, PRESTWICH. July 30th, 1834. A *loom shop*. EFFECTS.—A weaver at work killed. Some bricks displaced beneath window. *Chimney* shattered. [An. Reg. 108.]

(873) HULME, NEAR MANCHESTER. June 3rd, 1835. A small house. EFFECTS.—On ground floor, a man received a violent blow. In garret the *lead of casement* was melted. On window sill was a *tinder box*, "which was thrown to some distance." [An. Reg. 90.]

(874) PRESTON. June 4th, 1835. A weaving shop. EFFECTS.—Side of house much shaken. A woman sitting at her *loom* near chimney killed. *Chimney* flue struck. [An. Reg. 90.]

(877) CASWORTH HALL, NEAR DONCASTER. August 28th, 1838. EFFECTS.—A stack of *chimneys* thrown down on roof and interior much damaged. [An. Reg. 135.]

(878) DEVIZES CHURCH. July 27th, 1842. With steeple, *clock*, and *bells*. EFFECTS.—(1) Clock works destroyed, part of the metal being melted. Some of the bells injured. (2) Steeple rent in twain. Cost of damage, £1000. [An. Reg. 131.]

(879) WELTON CHURCH, NEAR LINCOLN. September 30th, 1847. Church had tower, *clock*, and pinnacles. An *iron rod* descended from clock into the church, and 3 small chandeliers hung by *iron chains* from the ceiling. EFFECTS.—(1) A man in a pew immediately beneath one of the chandeliers was killed. Other persons beneath the chandeliers were burnt or knocked down. (2) Clock rod and S.E. pinnacle of tower struck. [An. Reg. 119.]

(880) ST. SAVIOUR'S CHURCH, SOUTHWARK. July 26th, 1849. (1st time.) Tower with *clock.* EFFECTS.—A stone near clock knocked out and broken to pieces, the fragments breaking in the roof. [An. Reg. 80.]

(881) ROSS CHURCH. July 5th, 1852. With steeple, bells, *spindle*, and *vane.* EFFECTS.—East window "destroyed." Roof struck. Steeple split above belfry. [An. Reg. 99.]

(887) DUBLIN. June 30th, 1854. A private house. EFFECTS.—(1) In a lower room a man standing near a *looking glass* was killed. (2) In room above a quantity of earthenware was broken. [An. Reg. 105.]

(890) BRICKLAYER'S ARMS STATION, LONDON. August 13th, 1857. A goods shed, with *iron pillars* and *iron roof framing.* EFFECTS.—About 2 hours after stroke a length of roof about 350 feet in extent fell in, carrying with it pillars, girders, &c. [An. Reg. 155.]

(898) CROMER CHURCH, NORFOLK. July 5th, 1871. (1st time.) With tower, *clock*, and pinnacles. EFFECTS.—Clock injured. S.W. pinnacle cut in two. [An. Reg. 72.]

(899) PILSWORTH, NEAR BURY. May 15th, 1872. Farm. EFFECTS.—(1) Parlour on ground floor. *Sewing machine* thrown and broken, and chairlegs and backs smashed. Window panes blown out. Fireplace and *grate* broken to fragments. (2) Bedroom above. The thick hearthstone was "split up." *Fireplace* and *fender* broken to pieces. Large wardrobe broken from bottom to top. A window "demolished." A large breach made in chimney breast. (3) *Chimney* stack and gable wall containing flues of above-mentioned rooms thrown down. [An. Reg. 34.]

(906) PHILADELPHIA, N. AMERICA. 1787. House of Mr. Benjamin Franklin. *Iron lightning-rod*, surmounted by a *copper terminal* 9½ inches long. EFFECTS. — Nearly all copper terminal melted. [Duprez, 37. Arago, 72.]

(908) PHILADELPHIA, N. AMERICA. July 12th, 1770. House with *iron lightning-rod.* EFFECTS. —The rod was struck and the point melted. [Duprez, 31. Arago, 74.]

(909) HOUSE AT STOKE NEWINGTON. June 18th, 1782. A *leaden pipe* on outside, not reaching ground by 10 feet. Inside house were an *iron bell crank, bell wire*, and *drop bolt wire.* EFFECTS.—Outer wall of house pierced at lower end of lead pipe. Bell wire dispersed or melted. Drop bolt wire shortened. [Phil. Trans. 1783, p. 223. Mr. E. Nairne, F.R.S. Arago, 75.]

(912) BREAG, CORNWALL. January 12th, 1761. Parish church. Tower had *leaden roof.* EFFECTS.—Tower was rent almost from bottom to top. S.E. pinnacle split to pieces. Six battlements on tower torn off, and stones thrown to a great distance. [Phil. Trans. LII., 507. Rev. W. Borlase, M.A., F.R.S. Arago, 86.]

(913) AUTRASME, LAVAL, FRANCE. June 29th, 1763. Church with *gilt picture frames* and decorations and *pewter flasks.* EFFECTS.—Gildings blackened and flasks fused. On June 20th, 1764, exactly the same damage was again done. [Arago, 93.]

(916) NEWBURY, NEW ENGLAND, NORTH AMERICA. 1755. Church with wooden tower and steeple 140 feet high, with a *vane* on summit. *Bell* hung at a height of 70 feet. Near bell an *iron hammer* to strike the hours, and from tail of hammer a *wire* proceeded to a clock 20 feet below bell. EFFECTS.—(1) Between the ground and end of *pendulum* building was exceedingly rent and damaged. (2) "Spire split all to pieces, and the parts flung in all "directions." The wire was "exploded and dissi-"pated." Phil. Trans., XLIX, 305. Mr. Benjamin Franklin writing to M. D'Alibard. [Arago, 140.]

(917) PARIS, HOUSE IN RUE PLUMET. July 17th, 1767. EFFECTS.—*Gilt picture frame, lantern, iron stove*, and *iron articles* in a box "picked out" by stroke. [Arago, 140.]

(919) CAROLINA, N. AMERICA. Before 1760. House with *iron lightning-rod* consisting of an upper terminal and a small *brass wire* leading to an iron bar in the ground. On the ground floor in kitchen a *fowling piece* rested against the wall outside which the brass wire passed. EFFECTS. — Kitchen fireplace damaged. Butt of musket broken. Wall pierced at top of barrel. Brass wire melted. [Duprez, 51. Arago, 140. Harris, 206.]

(921) PHILADELPHIA, N.A. August 28th, 1760. Private house with *lightning-rod* formed of iron links. EFFECTS.—(1) Ground raised at base of rod and foundations of house damaged. (2) Links of rod unhooked and metal fused. (3) *Chimney* stack, to which rod was fixed, shattered. [Duprez, 51.]

(922) MANNHEIM, GERMANY. September 5th, 1779. House of Saxon ambassador. Fitted with several *iron lightning-rods.* EFFECTS.—(1) A "tour-"billon" of gravel or sand made at base of one of rods. (2) Rod bent for 2⅝ inches from end, and point melted. [Duprez, 34. Arago, 145.]

(924) ROUVROI ABBEY, NEAR ARRAS, FRANCE. February 24th, 1774. With spire and *weathercock.* EFFECTS.—(1) Pavement under porch of spire lifted vertically. (2) Spire struck, and weathercock thrown to a great distance. [Arago, 175. Quart. Review (1844).]

(934) HARROGATE. September 29th, 1772. House occupied by Mr. Thomas Heartly. Bedroom window had 6 *iron stay bars* and an *iron casement.* Bed on opposite side of room was a four-poster, with heavy *iron curtain rods.* EFFECTS.—(1) Three squares of glass in window were each perforated by a hole about 1 inch square. (2) Mr. H., lying in bed facing window, was killed, and his hair singed. (3) The bedpost was torn and split into many shivers. [Phil. Trans. LXIII. 177. H. A. XIII. (Rev. L. Kirkshaw, D.D., of Leeds.)]

(939) PURFLEET GOVERNMENT STOREHOUSE. May 15th, 1777. Fitted with 2 *lightning rods*, consisting of 5 iron upper terminals with copper points, and two leaden lower portions leading into 2 wells. *Iron clamps* to coping stones. *Lead hips, eaves-gutters*, and *rainwater downpipes* forming part of rod system. EFFECTS.—House injured at a place 24 feet horizontally distant from the rod, and 24 feet 9 inches vertically below its point. Here a portion of the outer cornice 7 inches thick, lying between the eaves-gutter and an iron clamp, and over a rainwater pipe, was pierced. [Duprez, 60. Arago, 237. Harris, 119.]

(942) TOOTHILL, ESSEX. June 18th, 1829. A windmill. EFFECTS.—(1) Stroke "tore up the stones "and gravel" near *iron braces* under stairs of round house. (2) "Tore up" floor of lower room near west side of mill, and threw some heavy *iron weights* into

the yard. Miller much maimed and scorched. (3) Welded into a solid mass the links of a certain length of the *iron chain* used for drawing up the sacks from lower floor. (4) Completely drove "off" the roof of the mill covered with *iron plates*, and "all the boards "round the mill" from the lower floor upwards. Fragments thrown far away. (5) "Rived" and "drove "off" a large portion of the *shaft* on the west side, destroyed the framework of the crown or *cogwheel*, "and in other respects damaged or displaced every "part of the *machinery*." (6) Struck off one of the sails on the west side, and snapped in two the timbers. Drove out an *iron bolt* from the opposite sail, and separated an *iron band* from it. [Howard, III. 32. Mr. Thomas Squire of Epping. Arago, 243.]

(943) MILAN CATHEDRAL. June 19th, 1819. On a pinnacle of the tower was an *iron lightning-rod*, leading into a paved cistern. EFFECTS.—At various points near the rod at different levels the marble was broken and dispersed. [Duprez, 53. Arago, 247.]

(944) GENOA LIGHTHOUSE. January 4th, 1827. An *iron lightning-rod* leading into a cistern excavated in the rock. EFFECTS.—Rod broken in several places and the lighthouse damaged. [Duprez, 54. Arago, 248.]

(945) CHARLESTOWN, U.S.A. July 31st, 1829. Prison. *Much iron* in its construction. Had 3 *iron lightning-rods.* Most of the prisoners and warders (300 in number) were at the time handling *hammers*, *files*, *guns*, or *pikes*. EFFECTS.—One or more rods struck. All inmates sustained a violent shock. [Arago, 250.]

(946) SEMINARY OF ST. ANNE D'AURAY. FRANCE. December 16th, 1852. An *iron lightning-rod* on the tower. EFFECTS.—(1) The stroke severely wounded (*blessa grièvement*) a workman sheltering under a roof at the foot of the tower. (2) The wall of room next sacristy was pierced at level of ground by two large breaches. (3) Rod broken at the stone gallery of tower, where, after having ascended vertically from the ground, it bent to follow the contours of a cornice. Small plates of lead at junctions of rod melted. The upper terminals had disappeared. [Duprez, 57. Arago, 251.]

(947) BAYONNE, FRANCE. February 23rd, 1829. Government powder magazine. Thick masonry vault, with sloping roof, gable ends, and masonry invert floor (to guard against damp). Had an *iron lightning-rod* carried outward from the foot of the wall at 2 feet above the ground on wooden posts, to which it was attached by *lead plates* into a pit 6 feet square filled with charcoal and loose earth above 33 feet from the wall. The sides of the pit were lined with masonry, but the bottom was formed by the moist earth. The gable ends were covered with large *leaden plates.* Roof surrounded with *leaden eaves-gutters. Iron clamps* to cornice stones. *Metal rain-water downpipes.* All the metallic parts of the roof were in connection with the rod. EFFECTS.—(1) The lead plates on the wooden posts were torn, and "some doubled up, and the nails holding them to the posts were drawn." (2) At the upper corner of the building distant from rod a lead plate at the gable near an iron cramp joining two cornice stones was rent. (3) The point of the rod was fused for a depth of ½ inch. [Sturgeon, 61. Duprez, 55. Arago, 252. Harris, 213.]

(949) VALLERA NEAR PARMA. Summer of 1831. Private house with a substantial iron *lightning-rod* ending in a well always holding water. EFFECTS. Rod much shaken and copper point fused. [Arago, 264.]

(951) ST. MARTIN'S CHURCH, LONDON. July 28th, 1842. Top of spire 200 feet from the ground. Consisted of a ringing chamber on level with church roof; above this chamber a clock room; above that a belfry, and over that a dial room. Above this again was an open cupola surrounded by columns and arches, and the spire proper, 44 feet high, surmounted the whole. The metals present were as follows:—(1) *Rainwater pipes* between ground and roof of church. (2) *Lead covered roof.* (3) *Clock works.* (4) Massive *iron clock frame* and *iron window frame.* (5) *Bells* weighing 5 to 31 cwt. (6) *Vertical iron rod*, ¾ inch in diameter, and 46 feet long, in lengths united by brass screws connecting clockwork with dial hands. (7) *Iron spindles* of clock faces in dial room. (8) *Lead covered floor* of cupola and leaden joints to stones adjacent. (9) *Framework of iron* and wood resting on floor of cupola. (10) Two strong *iron ties* to masonry. (11) Strong *iron cross frame*, weighing 12¾ cwt., supporting spindle, ball, and vane. (12) *Iron spindle*, 27 feet long and 4½ inches square, projecting 12 feet into the air. (13) *Gilt copper ball*, 1-16th inch thick, and 2 feet 9 inches in diameter. (14) *Gilt copper vane*, 8 feet by 6 feet. EFFECTS.—(*a*) Portions of lead roof slightly fused. (*b*) Clock-room floor left "as if blown "up by gunpowder." Door of clock casing burst open. Silver face of regulator blackened. Steel pivots of wheels magnetised. Glass of iron window frame shattered. Brass screws of vertical iron rod slightly fused. Gilt letters and minute hand of dial blackened. (*c*) Wooden framework of cupola shivered. Two stones thrown out, and two others dislocated. Some leaden joints of stones slightly fused. Joints of masonry all loosened, and spire generally left in a tottering condition. [Harris, 80. An. Reg. 131.]

(952) BRIXTON CHURCH, LONDON. April 24th, 1842. Has a massive dome of masonry resting on columns 12 feet high. Below these are successively clock room and belfry, the latter being on a level with the church roof. The metals present were as follows: (1) *Rain pipes* between ground and roof. (2) *Lead-covered roof.* (3) *Iron cramp* on belfry floor. (4) *Bells.* (5) *Iron wire* 30 feet long between bells and clockwork. (6) *Copper dial plate*, with gold leaf figures. (7) *Iron connecting rods* between dial plates. (8) *Lead-covered roof* to clock room. (9) Dome *joints soldered with lead.* (10) Horizontal *iron bars* supporting cross. (11) *Copper cross*, 4 feet 6 inches high. EFFECTS.—(*a*) Wires between bells and clockwork knocked to pieces and partly dissipated. (*b*) Base of a column at junction with leaden roof of church shattered. (*c*) Dome rent open. [Harris, 86.]

NOTE.—Church again struck and damaged in July, 1872. [Builder, Dec. 21, 1872.]

(955) NORMANHURST COURT, NEAR BATTLE, SUSSEX. July, 1880. Built of stone, with tiled roof. At one corner is a tower and spire 120 feet high. At another, 126 feet distant, a chimney shaft, with a coping of 8 pinnacles. Had *copper lightning-rods* with *iron points* on tower and chimney. At chimney shaft point of rod rose 3 feet above coping, and the rod was insulated from the chimney and

terminated in dry earth. EFFECTS.—(1) At a point 31 feet below summit the wires of the rod were damaged. Some wires near the terminal were fused. The terminal was bent, and some lead composition on the iron point melted. (2) Three pinnacles were destroyed. [Tel. Journ., 1/10/80. Mr. R. Anderson.]

(956) THE SORBONNE, PARIS. September 8th, 1880. Had *iron lightning-rods* consisting of 6 terminals, connected by an iron band making a circuit over the whole roof, connected to an iron rod leading into a pit. EFFECTS.—Two terminals were struck. [Tel. Journ., 1/10/80.]

(958) HOTEL DES INVALIDES, PARIS. June 8th, 1839. Had a dome and lantern. Fitted with an *iron wire rope lightning-rod.* EFFECTS.—(1) A few feet above the ground, at a place where the rope passed through an iron holdfast and was twisted twice round it, a length of at least 12 inches of the rope was broken and dispersed. (2) A small bath adjacent with a *lead waste pipe* was broken into 4 pieces. Several slates on the roof of bathhouse were riddled with holes. Four large panes of an adjacent window guarded by *iron bars* were broken in pieces. (3) Some *lead* round base of one of lantern columns was stripped off, and over a length of 65 feet of gilt lead round lantern dome the metal was raised and 60 nails violently drawn out and dispersed. [Comptes Rendus, VIII., 978. M. Bugnot, Inspector of Works.]

(959) CHARLES CHURCH, PLYMOUTH. Dec. 1824. Steeple fitted with a *lightning-rod of brass links.* The steeple was of granite, and surmounted with a massive metal *spindle, ball,* and *vane.* At foot of tower where rod entered ground was a shed with a slate roof. EFFECTS.—(1) Stroke "passed through" two or three graves, pierced churchyard wall 2 feet thick and threw some stones into the streets with great violence. (2) Door of shed was burst off *hinges*, and slates much injured. (3) From near the level of the ground to about a foot off tower window the rod "was broken "into short lengths much blackened and bent." [Mech. Mag. VIII., 13. Lt. W. Pringle Green, R.N. Harris, 104, 160. Description of building from writer's personal knowledge.]

(962) ST. BRIDE'S CHURCH, LONDON. June 10th, 1764. Had a stone spire formed of an obelisk resting on four successive stories of different orders of architecture, with a belfry beneath. The metals in the spire were as follows ;—(1) *Iron bars* supporting window heads of belfry. (2) *Iron cramps* to masonry. (3) Horizontal *iron bars* connecting piers in each story with *iron chain tie bars.* (4) *Iron collars* soldered with lead connecting upper course of obelisks. (5) *Iron spindle* (for vane), 2 inches square and 20 feet long, let in with lead. (6) *Ball, vane,* and *cross* of gilt copper. EFFECTS.—(*a*) The stroke made successive leaps between the metals, commencing at the west window of belfry. An iron cramp ½ inch thick and 2 feet long was broken in two, and one part bent at an angle of 45°. (*b*) 25 tons of stone burst, spoiled or so much damaged as not to be fit for use again and a stone weighing 70 lbs. thrown 50 yards. Effects "exactly "similar to those which would have been produced by "gunpowder." (*c*) The gilding at top of cross was discoloured. [Harris, 89, 102. Arago, 142. Phil. Trans., Mr. Delaval, F.R.S., Phil. Trans. LIV., 201. Dr. W. Watson, M.D., F.R.S.]

(964) PHILADELPHIA, N. AMERICA. Summer 1760. House with an *iron lightning-rod.* Point was of *brass.* The rod ended in an iron stake in dry ground. EFFECTS.—(1) Luminous streaks appeared at the base of the rod. (2) The brass point was fused. [Duprez, 31. Harris, 111. Anderson, 30.]

(966) TENTERDEN, KENT. June 17th, 1774. House with 4 *chimneys*, and to one was fixed an *iron lightning-rod*, lower portion of which rested on ground, and was partly formed of a *lead pipe. Hips* of roof, *eaves-gutters*, and *downpipes* of *lead.* A *copper bell wire* on outside of building, adjacent to lead portion of rod. EFFECTS.—(1) Part of copper wire where not painted was melted. (2) Between one of chimneys, 48 feet 9 inches distant from rod, and a lead downpipe, roof, at gaps between metal work, was considerably damaged. [Duprez, 60. Harris, 111 and 120.]

(967) STEEPLE-ASHTON VICARAGE, WILTSHIRE. June 20th, 1772. In kitchen premises were an *iron stove* and a hogshead of beer. In hall were *iron bell wires.* In parlour were *looking glass* over chimney piece, *clock, locked* bureau, and some *lead on windows.* Round *chimney stack* was an *iron hoop.* Inside, and near top of *chimney* flue, were some *iron bars*, forming part of an apparatus formerly used to prevent the chimney from smoking. EFFECTS.—(1) In the kitchen wall a hole 5 or 6 inches in diameter pierced. The bell wires almost entirely dissipated. Several splinters torn out of the hogshead. (2) In parlour the looking glass thrown on floor and broken, and some of the quicksilver melted. The clock case thrown forward and broken to pieces. The bureau broken open. The glass in window forced outwards, and some of the lead melted. (3) On first floor the panes in windows over parlour and kitchen forced outwards. (4) Large stones torn out of the wall near the chimney stack and thrown to a great distance. The ceiling and roof near the stack pierced, and the latter thrown down. [Phil. Trans. LXIII., 231. Mr. E. King, F.R.S. Harris, 112.]

(968) KINGSBRIDGE, DEVONSHIRE. June, 1828. Church with tower and spire, surmounted by an *iron spindle.* EFFECTS.—The tower was shattered. [Harris, 112.]

(973) HECKINGHAM POORHOUSE, NORFOLK. June 17th, 1781. Had 8 *chimney* stacks, and 4 *iron lightning-rods,* with 8 upper terminals, one fixed on each chimney stack. EFFECTS.—(1) A gate in front of the house struck. (2) An upper corner of the house, distant 57 feet 2 inches from the nearest lightning-rod, and 21 feet 10 inches below its point, was set on fire. (3) One of the rods appears to have been struck. [Duprez, 61. Harris, 119. Adams, 381.]

(982) GLOGAU, SILESIA. May 8th, 1782. Powder magazine with a *lightning-rod* leading into a well of water, and under guard of a sentinel. EFFECTS.—Rod struck and sentinel thrown down senseless. [Duprez 35, Harris 163.]

(986) VICTORIA RAILWAY STATION, LONDON. October 10th, 1878. A furniture warehouse at back of station. Brick building 110 feet by 80 feet. Flat roof, *covered with lead.* Tower at one corner with slated roof, and *iron cresting* 4 feet high on ridge. *Metal downpipes* from lead roof to ground. A copper *lightning-rod* on tower. EFFECTS.—(1) Tower considerably damaged. (2) Iron cresting shattered. (3) Rod bent. Two of its points driven out, and a third twisted. [Tel. Journ., 1/10/80. Mr. R. Anderson.]

(989) ST. MARK'S CHURCH, SKELTON, THE POTTERIES. June 10, 1880. Tower 16ft. square with 4 pinnacles. Roof slated. *Lead ridges* and *eaves-gutters.* In centre of tower a flagstaff. In tower were *gaspipes, clockworks,* and *bells.* A *copper lightning-rod* attached to one pinnacle. Rod distant 10 feet from flagstaff, and top 20 feet lower. EFFECTS.—Point of rod slightly bent. [Tel. Journ., 1/10/80. Mr. R. Anderson. Journ. R.U.S.I. (1880), 596.]

(992) PHILADELPHIA, N. AMERICA. June, 1770. A private house, with an *iron lightning-rod.* EFFECTS.—Point of rod melted. [Harris, 165 (quoting Arago).]

(995) ELSTREE, NEAR ST. ALBAN'S. July 28th, 1874. Manor Hall. EFFECTS.—(1) Nursery at top of house set on fire. (2) *Chimney stack* thrown down through roof and two servants killed thereby. [An. Reg. 77.]

(996) PLYMOUTH. May 25th, 1841. Royal William Victualling Yard. *Chimney* shaft of the bakehouse. Round granite shaft 120 feet high. At 60 feet below top was extensive *copper roofing* of bakehouse connected to ground by *metal pipes.* EFFECTS.—Chimney rent for the length of 60 feet above roof of bakehouse. [Harris, 168 and 180.]

(997) ST. PETER'S CHURCH, LONDON. Summer, 1774. With brick tower and spire surmounted by *large gilt copper key.* Roof of spire and church *covered with lead.* Thence *metal pipes* to ground. EFFECTS.—Tower much rent between lead roof and lead covering of spire. [Harris, 168.]

(1003) NEW CHESTER. N. AMERICA. (No date given.) A private house. With a *chimney stack* at each end. A *lightning-rod* on each stack. Near west rod *a copper eaves-gutter* and *rain downpipe* passing to within 4 feet of a cistern on ground. EFFECTS.—(1) Ground at foot of rod "torn up." (2) Building damaged near eaves gutter. (3) Roof shingles "torn "up" between gutter and west chimney stack. [Harris, 217. Duprez, 58.]

(1006) ST. MICHAEL'S CHURCH, BLACK ROCK, NEAR CORK. January 29th, 1836. With stone spire, strengthened by *iron cramps* and *bars* within and without. EFFECTS.—Whole of windward side of spire rent open. Top of spire thrown down, and the stones scattered. [Harris, 91.]

(1007) CHRIST CHURCH, DONCASTER. Nov. 3rd, 1836. With spire 150 feet high. Apex formed by a small pointed conical piece of glass. Tower had ½ inch *copper gaspipes* between clock dials and ground, clock with *iron* framed dials, *bells,* a *copper wire* between bells and clockwork, *lead eaves-gutters,* and short *lead downpipes.* EFFECTS.—(1) About 6 feet below window of clock chamber gaspipe was melted. Glass of dials shivered to atoms. (2) Beam through which copper wire passed much rent. (3) From opposite bell to end of a lead pipe stonework of window much damaged. (4) Lower portion of spire fractured in several lines. Stone of window near eaves-gutter much shattered. Upper 12 feet of spire thrown down. [Mech. Mag. XXVI. 178. "J. R. H.," an eye witness. Harris, pref. and 130.]

(1008) CHURCH OF NOTRE DAME DE LA GARDE, GENOA. August 24th, 1779. With a tower, *bells,* and *iron cross.* On tower an *iron lightning rod,* partly inside building. Tower strengthened by *iron bars.* EFFECTS.—(1) Paving stones were lifted in several places. Some persons in portico thrown down. (2) Walls adjacent to iron bars rent. (3) Point of rod partly melted and partly split open. Duprez, 52. Harris, 209.]

(1011) ST. NICHOLAS CHURCH, WELLS, NORFOLK. August 3rd, 1879. With lofty tower at west end containing *clock and* 8 *bells.* Vestry and three stained glass windows at east end. Nave *roof covered with lead.* EFFECTS.—(1) Church and vestry simultaneously set on fire. The stained windows destroyed. (2) On the east side of tower a patch 10 feet by 5 feet between lead roof of nave and east window of tower was "skinned of stones," which were thrown to a great distance. [Ill. Lond. News, 30/8/79. L.R.C. 195. Mr. F. Long.]

(1012) CONCORDIA, ARGENTINE REPUBLIC. May 31st, 1875. One-storeyed house. Flagstaff over front door held to parapet by *iron staples.* Floor at front door paved with tiles. *Iron shield* over front door. EFFECTS.—(1) Tiles torn up at foot of lower *bolt* of door. Wall rent from shield to heel of flagstaff. (2) Flagstaff split longitudinally into several pieces, and one piece thrown far away. [Tel. Journ., 15/9/75. Mr. J. H. Blomfield, of Concordia.]

(1014) BARRACKPORE, INDIA. July 31st, 1877. Barracks with an *iron lightning-rod.* Verandah had roofs supported by *iron girders.* EFFECTS.—A hole pierced through cement roof of verandah between a girder and horizontal portion of rod lying on roof. [Journ. Soc. Arts (1878), 323. Dr. R. J. Mann, M.D.]

(1015) NATAL, S. AFRICA. About 1878. House with a *galvanised iron roof* and two *iron lightning-rods,* but neither connected to the earth. EFFECTS.—Farmer (entering house) killed. Two children hurt. [Journ. Soc. Arts (1878), 330. Dr. R. J. Mann, M.D.]

(1018) ALL SAINTS' CHURCH, NOTTINGHAM. October 16th, 1868. Tower and spire 150 feet high. With *copper lightning-rod* passing through insulators. Inside tower against wall along which rod passed was a *gaspipe.* EFFECTS.—(1) Wall between gaspipe and rod 4 feet 6 inches thick, pierced, and hole made in gas pipe. [Journ. Soc. Arts (1875), 518. Dr. R. J. Mann, M.D.]

(1027) THE LOUVRE, PARIS. December, 1854. (2nd time.) With *lightning-rods.* EFFECTS.—Building slightly damaged. [Anderson, 80.]

(1028) ROSTALL CHURCH, FRANCONIA. April 30th, 1822. With steeple containing *clock* and other *metals.* A *brass lightning-rod* attached. EFFECTS. (1) Part of lower wall thrown down. (2) Clock thrown down. (3) Point of rod melted. [Anderson, 165.]

(1029) BRUNTCLIFFE, YORKSHIRE. August 6th, 1878. A small powder store 7 feet high. Fitted with a *copper lightning-rod* fixed to a pole about 2 inches from one end of building, and having good earth connection. Point surmounted building by 13 feet. An *iron door* at end remote from rod not connected to the ground or to the rod. EFFECTS.—Powder set on fire, store blown up and two children injured. [Report H.M. Inspector Expl., 17/9/78. L.R.C. 74.]

(1030) CROMER CHURCH, NORFOLK. Aug. 1879. (2nd time.) With tower 159 feet high and pinnacles. A *copper lightning-rod* at one pinnacle. EFFECTS.—A pinnacle 27 feet 6 inches distant from that carrying the rod was damaged. [Anderson, 147.]

(1031) LAUGHTON-EN-LE-MORTHEN. May 1879. Church with steeple 175 feet high, surmounted by *vane.* Tower below with *lead covered roof* and *cast iron downpipes.* A *copper lightning-rod* attached to spire, distant 6 feet 6 inches from lead roof, and passing through insulators. EFFECTS.—(1) Buttress pierced between lead roof and rod, and about 2 cart-loads of stone dislodged. (2) Rod thrown down, and upper terminal broken in two pieces. [Anderson, 153.]

(1032) ST. GEORGE'S CHURCH, LEICESTER. August 1st, 1846. With tower, pinnacles, and steeple. Metals present :—(1) *Cast iron downpipes* from roofs of church. (2) Leaden *eaves-gutters* of church. (3) *Lead flushings* and *ridges* to roofs of church. (4) *Cast iron windows* in tower. (5) *Clock* works and dial faces. (6) Large *leaden window* at top of spire. (7) *Cast iron downpipe* from tower roof to church roof. (8) Leaden windows in spire. (9) *Copper bolts* and *iron cramps* to stone blocks of spire. (10) *Spindle* with *iron supports* and *gilt vane.* EFFECTS.—(*a*) All the cast iron spouts more or less broken. (*b*) Overlapping of lead gutters, flashings, and ridge covers forced asunder, and in many places fused. (*c*) Roof of wings covering gallery stairs brought down. (*d*) Part of main roof of church broken through. (*e*) Leaden windows of tower and steeple all blown outwards. (*f*) Spout between church roof and tower roof shivered and displaced. (*g*) Steeple burst asunder and the stones thrown far away. (*h*) Vane rod and top of spire fell down, carrying with them the bell and clock works. Cost of repairs, £2,300.

NOTE.—It was calculated that the work done by the explosion was 360,000 tons raised 1 foot high in 1 minute. [Journ. Soc. Arts (1846). Mr. E. Highton, C.E., who examined scene.]

(1033) MERTON COLLEGE CHAPEL, OXFORD. September 27th, 1875. Tower with pinnacles and *vanes,* tower roof of *lead.* EFFECTS.—(1) Pinnacle severed from base to summit. (2) Vane slightly fused and thrown on to roof. [Anderson, 182.]

(1034) ST. MARK'S CHURCH, WREXHAM. June 8th, 1879. With copper *lightning rod* on spire. EFFECTS.—Six persons in tower below spire slightly burnt, and spire rent. [Anderson 185.]

(1039) SOUTH MOLTON CHURCH, DEVONSHIRE. June 6th, 1751. With tower, steeple, *clock, bells* and *iron spindles.* EFFECTS. — Clock stopped. Bells and spindle much damaged. Many stones splintered and broken. [Phil. Trans., XLVII. 330.]

(1040) NEWBURY CHURCH. June 16th, 1754. With *belfry. Metals* forming "accidental conductor." EFFECTS.—"Accidental conductor" melted. [Anderson, 186.]

(1042) ALTONA CHURCH, DENMARK. July 16th, 1760. *Ditto, ditto.* [Anderson, 186.]

(1045) ST. PAUL'S CATHEDRAL, LONDON. March, 1772. Dome with *lightning-rod* and *other metals.* EFFECTS.—Portion of rod made red hot. [Mech. Mag., VIII. 286. Lieut. W. Pringle Green, R.N. Anderson, 186.]

(1047) SHAUGH CHURCH, DEVONSHIRE. February, 1823. With a tower and pinnacles. An *iron lightning-rod* attached to one of pinnacles. In a rusty state. EFFECTS. — The tower was greatly damaged. [Anderson, 186. Duprez, 54.]

(1050) EALING CHURCH, NEAR LONDON. June, 1854. With an *iron lightning-rod.* EFFECTS.—The rod melted, and the church damaged. [Duprez, 57.]

(1053) ASHBURY CHURCH. July, 1854. With an *iron lightning-rod.* EFFECTS.—(1) Some stones displaced and broken. (2) Rod melted. [Duprez, 57.]

(1054) CHARTERED GAS COMPANY'S WORKS, BRICK LANE STATION, LONDON. August 13th, 1857. *Gasholder.* EFFECTS. — *Iron columns* struck. Gas ignited. [A. R. 155.]

(1055) ST. MARY'S CHURCH, GENOA. July, 1779. Much *metal* inside and outside church. *Iron cramps* connecting hewn stones of structure. Fitted with a *lightning-rod.* EFFECTS.—Cramps and metals struck. Masonry shattered. [Anderson, 201.]

(1056) ALATRI CATHEDRAL, ITALY. Nov. 2nd, 1872. (4th time.) With 2 *copper lightning-rods,* one on belfry, the other on choir. *Water pipes* passed about 33 feet from underground portion of one of rods. EFFECTS.—(1) A ditch ploughed between pipes and rod 2 feet 4 inches deep. (2) One pipe broken, and lead at joint melted. (3) Some wooden plugs of discharging tubes at reservoir forced out. (4) Point of rod broken. [Eng. Mech., 27/12/72 (Father Secchi). Anderson, 203.]

(1057) CLEVEDON CHURCH, SOMERSETSHIRE. March 15th, 1876. Tower with flagstaff and 4 pinnacles. A *copper lighting conductor,* with 5 upper terminals, one on each pinnacle and flagstaff, passed down inside tower, and emerged at some distance below *clock. Gas meter* and *pipes* inside tower against wall, 3 feet thick, outside which rod passed. EFFECTS.—(1) Wall between gaspipe and rod pierced. (2) Rod struck. [Anderson, 208 (Mr. Eustace Butler, in Proc. Soc. Tel. Eng.)]

(1058) LYONS, FRANCE. Before 1880. A banker's house, with a large *iron safe* and an *iron lightning-rod.* EFFECTS.—Some *gold* in safe melted, and bank notes burnt. [Anderson, 220.]

(1059) HALIFAX, N.S. Summer, 1871. Old Provincial Buildings. *Gaspipes* and *meter* in basement. EFFECTS.—Gaspipe fused and gas lit. [W. O. Inst., 1875.]

(1060) JAMAICA. July 28th, 1857. Compton Lodge. An *iron lightning-rod* distant 10 feet from S.E. corner of building. EFFECTS.—S.E. corner shattered. [W. O. Inst., 1858, App.]

(1079) EAST LONDON, SOUTH AFRICA. 1855. A powder magazine. With an *iron lightning-rod* ending in a dry water tank. EFFECTS.—Building much damaged. Rod "torn to pieces." [Journ. Soc. Tel. Eng., 12/5/75.]

(1080) COAST OF IRELAND. March 13th, 1844. A martello tower, containing a powder magazine. An endless *iron racer* on a banquette on flat roof. A flagstaff fixed on banquette, with its foot close to racer. At foot of banquette was the mouth of a *lead rainwater pipe,* that proceeded round outside of tower, and terminated over a *tank* on ground nearly opposite flagstaff. It projected over tank, but without touching it. EFFECTS.—(1) Pipe burst at end over tank. (2) Between mouth of lead pipe and racer the stroke broke out a piece of masonry and threw it 50 yards. (3) Racer disturbed, and masonry at foot of flagstaff shaken. (4) Truck of flagstaff destroyed. [Aide Mémoire to the Mil. Sciences, I. 391. Col. R. J. Nelson, R.E.]

(1081) BULL POINT, NEAR DEVONPORT. July 7, 1872. War Department Powder Magazine Establishment. A cookhouse just outside walls. With *boiler*, *range*, *iron soot door* in flue, *eaves-gutters* and two *cast iron downpipes* (latter not reaching ground). EFFECTS.—Soot door knocked out. *Chimney* stack fractured. Chimney pot thrown down. [Scene examined by the writer, and particulars collected by him.]

(1083) HUNTFIELD HOUSE, CHEPSTOW. April 6th, 1880. EFFECTS.—(1) Pavement smashed up, and an *iron gate* in front of house burst from its hinges. (2) Everything metallic blackened in dining and two other rooms. (3) *Chimney* stacks shattered. [West. M. N., 8/4/80.]

(1088) ST. MATTHEW'S CHURCH, LEICESTER. June 18th, 1880. Ornamental *finial* over east window. EFFECTS.—Wooden roof set on fire. Finial struck. [West. M. N., 19/6/80.]

(1103) IDE, NEAR EXETER. July 13th, 1880. Two cottages, adjoining each other, built of rubble masonry plastered, two stories, and thatched with straw. EFFECTS.—(1) North cottage. A small crack in north (gable end) wall from an *iron damper* in kitchen *chimney* breast (above range) to lower *hinge* of a bedroom door on floor above. Above hinge woodwork of door torn away. Crack proceeds up wall close to chimney stack through roof thatch, which was here set on fire. (2) South cottage. A person on ground floor knocked down. Three patches of plaster thrown off various walls in ground floor, and two from party wall in room above. Some *gilding* rubbed off two pictures hanging on back (east) wall of latter room. [Scene examined and particulars collected by the writer.]

(1105) VENICE. Summer, 1871. A powder magazine. With an *iron lightning-rod*. EFFECTS.—Rod split and twisted, and platinum point melted. [Pop. Sc. Rev. x. 113.]

(1106) OUNDLE CHURCH, NORTHAMPTONSHIRE. March 20th, 1693. With steeple and windows therein made of *lead sheets perforated with holes*, and framed in wood. EFFECTS.—Steeple set on fire at wood framing of a window. [Phil. Trans., XVII. 711.]

(1110) ST. PETER'S CATHEDRAL, ROME. Before 1811. (1st time.) With dome, *copper ball*, and *cross*. EFFECTS.—(1) "Several great stone steps dis-"located and cast abroad." (2) Copper ball riddled. [Mech. Mag., XXXVII. 600. Mr. F. Macerone.]

(1116) MANAYUNK, PHILADELPHIA. Summer 1871. The "Pekin" Woollen Mills. With *iron lightning-rods*. EFFECTS.—Set on fire and destroyed. Estimated loss, £10,000. [Eng. Mec., 31/5/72. Professor John Wise at Wagner Institute.]

(1117) PHILADELPHIA. Summer, 1871. Pattern shop of Morris and Co. With *iron lightning-rods*. EFFECTS.—Set on fire and destroyed. Estimated loss, £10,000. [Eng. Mech., 31/5/72. Professor John Wise at Wagner Institute.]

(1118) COUNT ORSINI'S CHAPEL, CARINTHIA. Summer, 1781. (1st time.) Tower with an *iron lightning-rod*. EFFECTS.—Rod struck. [Duprez, 35.]

(1119) DORTMUND, WESTPHALIA. January 11th, 1815. (3rd time.) Church of St. Regnauld. Had a tower containing *bells*, surmounted by a *pointed copper star*, and fitted with an *iron lightning-rod*. Roof of nave *covered with lead*. EFFECTS.—Rod struck. [Duprez, 37.]

(1126) (1127) NICOLAI CHURCH, GRIEFSWALD, PRUSSIA. Before 1876. On two separate occasions. Tower with *lightning-rod*. EFFECTS.—Rod struck. [L.R.C., 235. Prof. Kirchoff, of Berlin.]

(1128) CHURCH OF ST. CLOTILDE, PARIS. Between 1863 and 1872. (2nd time.) Had two *iron lightning-rods*, with 5 upper terminals. Rods surrounded building, and led through insulators into two walled wells of water. Building had *iron roofs*. EFFECTS.—Rod struck in 1863 again struck, and *copper point* bent. [L.R.C., 69. M. Francisque Michel.]

(1129) CHURCH OF ST. CLOTILDE, PARIS. January 1872 or 1873. (3rd time.) EFFECTS.—(1) One of stones above a staircase window shattered. (2) Rod on western tower struck. [L.R.C., 69. M. Francisque Michel.]

(1130) CHURCH OF ST. CLOTILDE, PARIS. Between 1873 and 1875. (4th time.) EFFECTS.—One of rods struck. [L.R.C., 69. M. Francisque Michel.]

(1131) (1132) (1133) ALATRI CATHEDRAL, ITALY (1st, 2nd and 3rd times). On three separate occasions between 1864 and 1872. With 2 *copper lightning-rods*. EFFECTS.—One of rods struck. [And. 203 (Father Secchi).]

(1134) (1135) (1136) ST. PETER'S, ROME (2nd, 3rd and 4th times). On three separate occasions between 1811 and 1837. With dome, *copper ball*, *cross*, and *numerous lightning-rods*; that at cross surmounted it by 15 feet, and had a point of *pure gold*. EFFECTS.—One of rods struck. [Mech. Mag., XXVIII. 68, and XXXVII. 600. Mr. F. Macerone.]

(1137) BREMEN. September, 1772. Church of St. Anscharie. (2nd time.) With tower and spire 335 feet high. Spire with *copper covering* surmounted by a *cross*. A copper *lightning-rod* from covering to surface of ground. EFFECTS.—Rod struck. [Duprez, 32.]

(1138) NICOLAI CHURCH, STRALSUND. 1856. (1st time). Had a *lightning-rod*. EFFECTS.—Rod received several strokes this year. [L.R.C. 235. Prof. Kirchoff (of Berlin).]

(1141) KIMBLESWORTH, DURHAM. July 12th, 1880. Colliery. *Boiler chimney*. With *lightning-rod*. EFFECTS.—Rod damaged. [Trans. N. of E. Inst. M. and M. E. XXX. 129. Mr. John Daglish.]

(1143) LANCASTER, PENNSYLVANIA, U.S.A. 1870. Several houses in the town with *iron lightning-rods*. EFFECTS.—The houses "were badly damaged "and set on fire." Those houses without rods that were struck were less damaged, and none of them set on fire. [Chamb. and Co. Circ. (1882), 17. Professor Wise.]

(1145) CASTLETOWN, BEREHAVEN, Co. Cork. Nov. 22nd, 1883. A farm house. EFFECTS.—(1) Stroke "tore up the flagged flooring in the kitchen." (2) A child had "the flesh of its legs stripped off." (3) *Chimney* struck. [Stand. 23/11/83.]

Space has not been available for insertion of the details of the following 83 cases: viz.—(99) Addiscombe (chimney), (216) Paris, (227) Waterford (cottage, person killed), (296)

Strasburg Cathedral (fourth time), (298) Epsom, (336) Fougères Barracks, (372) Seringapatam (399) Stanhope (chimney), (420) Wakefield, (425) Ripon, (438) Overheage (chimney), (443) Wigton (chimney), (444) Silloth, (455) Mitchell Troy Observatory, (468) Acomb (chimney), (487) Bedford (chimney), (543) Penegoes (cottage, person killed), (544) Smallburgh School, (547) Boxford (cottage, person hurt), (562) Bromley (chimney), (572) Northam (chimney), (584) West End Telegraph Office, (587) Coventry, (589) Virginia (lightning-rod), (593) Sienna (lightning-rod), (594) Padua (lightning-rod), (596) Hamburg (lightning-rod), (601) Zurich (lightning-rod), (609) Berne (lightning-rod), (610) Berne Museum (lightning-rod), (613) Belzig (lightning-rod), (614) Landshut (lightning-rod), (658) Morecombe Bay Monument (lightning-rod), (686) Gloucester, (710) Holloway Head Windmill, (719) Warley Common, (728) Birmingham (chimney), (737) Dover (chimney), (747) Northampton, (751) Great Cressingham Rectory, (754) Chippenham Windmill, (755) Monorgan, (758) Wellingborough (cottage, person killed), (788) Skipton Church, (801) East Retford, (815) East Norton (chimney), (817) Batheatsen, (819) Birmingham (chimney), (868) Thornley Bank (chimney), (870) Newton, (885) Hundleby Windmill, (892) Reading Foundry, (895) Kilburn (chimney), (907) Cremona Tower, (918) Naples, (936) St. Philemon's (Liverpool), (938) St. Petersburg (lightning-rod), (940) Eastbourne, (941) Lausanne Cathedral, (974) Edinburgh (lightning-rod), (978) Dutch Church (lightning-rod), (979) Count Orsini's Chapel (lightning-rod), (983) Bishop Stortford Church, (994) Sheffield (chimney), (1005) Chowringee (lightning-rod), (1010) Pennsylvania Oil Tanks (lightning-rods), (1019) A house in England, (1020) Ditto (with lightning-rod), (1026) Chelsea (chimney), (1035) Winterthur Church, (1036) Bologna Monastery (1038) Witzendorf Church, (1043) Nicholas Tower, (1044) Kiel Church, (1077) Guildford (chimney), (1078) Valetta, (1084) Ashford (farm house), (1086) Appledore (chimney), (1089) Bristol (chimney), (1096) Sheffield (chimney), (1100) Tenterden (farm house, person hurt), (1111) Paris (lightning-rod).

PRACTICAL DEDUCTIONS.

After perusing the records here presented, probably few persons will be inclined to doubt that both metals and chimneys are sources of danger to buildings; and I now propose to submit a few suggestions tending to show how architects may, in a great measure, avert the chances of injury to their constructions from the terrific blows of the physical force stored in the earth, without at the same time devoting an undue amount of attention to the possibility of the occurrence of these dangers. Such measures as I will now propose are by no means to be accepted as exhaustive remedies, but simply as *precautions* which are likely to be beneficial.

Precautions in regard to the use of Metals.—In the case of buildings considered by the designer, owner or occupier, to need special measures of defence, it may safely be accepted as a sound general principle that the use of metal in any form, whether outside or inside the building, should be minimized. It is possible however to particularize, to some extent, in respect of the architectural arrangements whereby this principle may be judiciously applied. And to this end I will treat separately of the metallic articles in ordinary use.

(1) *Lightning-rods.*—These apparatus are necessarily the highest points in the building.

If these prominent metals were not the first to be excluded from buildings, it would be absurd to exclude any metals at all.

(2) *Vanes, weathercocks, finials, crosses, balls, spindles, and other elevated metals.*—These ornaments are, in my opinion, as useless as they are dangerous. It is, moreover, mainly a matter of taste whether under any circumstances these metallic vanes and finials be not disfigurements rather than improvements. Carved bosses, crosses, or other stone terminals, in reality, constitute truer and better architecture. Terra cotta might also probably be used with advantage for these ornaments.

(3) *Bells and clocks in towers, and in elevated portions of buildings.*—So far as practicable I would omit these dangerous metals equally with vanes and finials. If, however, in any particular cases, bells and external clocks should be urgently needed, could they not be placed in separate low belfries or clock turrets, specially built for them?

(4) *Iron-ridge crestings.*—At the present time these ornamental crestings seem to be greatly in fashion. Whether they are disfigurements or embellishments, is again, as in the case of metal vanes, a matter of doubt. That they are totally useless is a matter of certainty. Could not tile or terra-cotta ridges be made to answer all the decorative purposes needed?

(5) *Iron balconies.*—These appendages to houses in a climate like that of England would seem, judging from the experience of London and other large cities, to be of an exceptionally useless character.

(6) *Chimney pots.*—These should never be of metal.

(7) *Flashings, hips, and other lead work on roofs.*—I would substitute fillets of asphalte or of Portland cement.

(8) *Eaves-gutters, and rainwater pipes.*—I would substitute terra cotta, earthenware, or other pottery.

(9) *Wire guards to stained windows*—I would substitute stout glass shields.

(10) *Tie bars, cramps, and hoop-iron bond.*—I would avoid tie bars altogether, and use slate dowels in place of cramps.

(11) *Roof framing.*—Trusses, girders and joists, of iron, should be excluded.

(12) *Slate roofs.*—The copper nails by which the slates are fixed are elements which should not be overlooked. In regard to lightning strokes, tiled roofs are safer.

(13) *Iron window bars.*—These are hardly ever a necessity except on the ground and basement floors, and they should be used as sparingly as possible.

(14) *Flooring.*—Iron columns, girders, and joists should be excluded.

(15) *Gas pipes and water pipes.*—If avoidable these should not be fixed on the outer walls.

(16) *Large chimney glasses.*—These and all other purely ornamental mirrors (such as pier glasses) should certainly be absent from a house the occupier of which is apprehensive of danger from lightning strokes.

(17) *Gildings.*—All gildings on cornices, walls, and wall papers should also, in such a case, be avoided.

(18) *Organs, pianos, safes, and large iron bedsteads.*—These and other metallic masses should not be in close proximity to the outer walls.

The foregoing list probably comprizes the chief metals met with in the construction and occupation of ordinary dwelling houses, churches and public buildings, but the general

principle is to be borne in mind rather than any special application of it. It is unreasonable to imagine that a building can be designed (as is now the practice) without the slightest reference to the physical conditions of lightning strokes, and to conceive that all injury from the latter can be warded off by simply inserting at the end of a specification, "Provide a proper lightning conductor," or words to that effect. This is acting as if a "lightning conductor" were a sort of fetish, charm, or quack specific warranted to cure all thunderstorm plagues.

Before I enter upon the subject of chimneys it should be observed that there are special cases (relating more to engineering than to architectural construction) where the bulk of the work is necessarily formed of metal. Such for instance are gas holders, oil tanks, large railway stations, and temporary erections of corrugated iron. The precautions we have to take in these cases consist in metallically connecting the ironwork of the building to the ground at one or more places, and in providing its most elevated metals with short spikes surmounted by very sharp points. Thus the metallic mass becomes converted into what may be called an *electric tap*, tending to eject all the charge that may accumulate in the ground near its base, by means of the physical property possessed by metal points, of throwing off and dispersing any charge which may enter the conductor to which they are connected. This power appears to have been first discovered by Mr. Thomas Hopkinson, an American gentleman, in the year 1747. He communicated it to Benjamin Franklin, who in his letter from Philadelphia to Mr. Peter Collinson, F.R.S., of September 1st, 1747, was the first to publish the great discovery to the world. It was this property and this property alone that originated in Franklin's mind the first idea of the lightning rod. After he had made known this invention to the world, in 1752, the *savants* of Europe appropriated it, as it were, into their gallery of scientific theories, but merely as a conductor of a supposed "electric fluid," darting from the clouds into the earth. They practically ignored its origin and its first intention as an electric tap, and, remarkably enough, so did Franklin himself. But, in my opinion, it is abundantly clear from Franklin's letters that he did not profess to be a physicist; nor is it probable that, practical as he was in all his ways, he much cared to investigate closely the true theory of his invention.

Precautions in regard to Chimneys.—The measures I propose to adopt in regard to chimneys are similar to those just mentioned in the case of metal buildings, and I would attempt to render chimneys as nugatory as possible and to take out, so to speak, their sting by tapping the ground beneath them of its superfluous electricity. The following are the arrangements proposed:—(*a*) At the grates or ranges on the lowest floor of the building, connect the metal work to the soil below by means of two iron bands, one at each side, say 3 inches by $\frac{1}{8}$ by 24 inches long, securely riveted or fixed to the foot of the grate's front, and passing down through the hearthstone, and rubbish or concrete underneath about 12 inches into the actual soil. The adjacent hearthstone should be easily moveable, so that the occupier may be able to satisfy himself that the earth connection is good. (*b*) Fix securely and closely to the top bar of the grate two short iron spikes 3 inches long, one at each side, close to the cheek of the fireplace, and leaning back obliquely towards the flue, at an angle of 45°. The spikes should be very sharply pointed with steel, and should be *kept* constantly sharp. It is probable that no inconvenience would be found to ensue from this arrangement

so far as the use of the grate was concerned. It is submitted that the adoption of these precautions (the cost of which is merely nominal) would greatly tend to save life in rural districts; and it is suggested that all dwelling houses in the country would reap much benefit if their grates were thus treated. The furnaces of boiler chimneys could be dealt with in a similar manner. But before all, the abolition of *unnecessary* metal from the building should be insisted on.* In the dwellings of the many, *i. e.* in cottages,† there seems no reason why the outside of the building should possess any metal at all other than that small amount inseparable from windows and doors in the shape of locks, fastenings, &c. And if, in addition, the kitchen grates were "tapped," I believe that (in our present state of physical knowledge) all reasonable precautions to prevent these abodes of the poor from becoming the scenes of death by lightning strokes would have been entertained.

ARTHUR PARNELL.

[Remarks by Mr. G. J. Symons, F.R.S.]

The Paper all through is one which has almost taken away my breath, in consequence of the wonderful way in which from it we appear to have gone back a century, and find ourselves in 1774 instead of 1884. One of the queerest things that Colonel Parnell has done is to contradict the book he brought out a little while ago, the title of which is *The Action of Lightning*. I will read you a passage from page 200 :—

"It follows, from what has been advanced, that towers, spires, domes, belfries, columns, tall chimney stalks, and all prominently elevated features of brick and stone buildings, are, *per se*, sources of danger, and that this danger is much enhanced by the presence of elevated metal not connected to the ground, *e. g.* roofs, spindles, finials, weathercocks, vanes, crosses, chimney-pots, ornamental ridges, and eaves-gutters.

"Owing to the great danger occasioned by metal local dielectrics, it might in some instances be of advantage to mitigate this danger by connecting the metals to the ground, thereby converting them into local plates."

He might as well have said converting them into "imperfect conductors." If you have a lot of disjointed metals in a tower it is an evil, and there is not a great amount of conducting power; but if you join them you make an almost perfect conductor.

One part of the Paper to a certain extent appeals to our sympathies, but we may dismiss it very briefly. The author suggests that the cottages of the poor are frequently struck. The argument was apparently based upon the fact that a large number of persons killed by lightning belong to the lower orders; but no evidence was produced to show that they are killed in their cottages. The real explanation is, I believe, that the agricultural labourer is usually in the field and generally has his hay-fork, or metal of some kind, in his hand, and while standing in the field he is much exposed and likely to be struck. As regards the frequency of small houses being struck as compared with large ones, small houses are much

* I would never add metal to a building; for it seems certain that the attraction varies as the amount of metal employed.—A. P.

† In the list (pp. 59-84) the following are cases of death or injury in cottages and farmhouses, viz. :— Nos. 91, 113, 176, 227, 270, 273, 280, 297, 299, 352, 437, 440, 442, 543, 547, 693, 702, 758, 810, 869, 873, 874, 1084, 1100, 1145; total 25 cases. In Nos. 138, 504, 704 and 899, these buildings were struck without injury to the inmates. In my complete list there are 24 additional instances of cottages or farm-houses being struck with death or injury to the inmates, and 9 without these disasters. Altogether, then, I have collected (up to date) 62 incidents of destruction at these agricultural dwellings.—A. P.

lower, and yet Col. Parnell all through was at pains to show that high buildings are the most frequently struck. The leading feature of the Paper is that we are not to have conductors; but look at the case (92):—" Parish Church of Week St. Mary, Cornwall, Nov. 8, 1878," the tower of which had been struck in 1688, 1812, 1843 and 1865. Details of the latest disaster are from the Rev. G. Hopkins, Rector, and Mr. J. P. St. Aubyn. Here is the same church struck five times over, and that church never had a conductor. If we are to have no conductors the result is that we are to be struck as often as Week St. Mary Church. I go on to the next case: —" (102). St. Michael's Church, Stamford, Aug. 14, 1857. Tower with pinnacles. At base of S.E. " pinnacle a 3-inch *iron rainwater pipe* entering the earth." The effect of the discharge " was " to uplift the whole mass, imparting to it at the same time a kind of circular motion to the " southward, the apex of the pinnacle falling in a line with its original base; and the base " having traversed about the eighth part of the circle, fell into the roof of the tower. The " pinnacle was a mass of masonry bound by *iron clamps,* and weighing about 15 cwt." All the damage was *above* the 3-inch iron pipe. The charge ran down the iron water pipe and ran away without doing further damage; and if they had had a conductor running upwards the thing would have been all right; if, as suggested, they had had a terra-cotta pipe, in all probability the whole tower would have come down. The next case is not very pleasant:— " (110). Nash Low Lighthouse, Aug. 31, 1852." Description from Professor Faraday. That is quoted from the full report, Lightning Rod Conference, p. 187; but Col. Parnell did not quote what Faraday (no mean authority) had to say about it. His remark is simple: " It is manifest " that the discharge upon the tower was exceedingly powerful, but the lightning-conductor " has done its duty well—has, I have no doubt, saved the building." That ought to have been given. The case at Upwood Gorse, Caterham, is also quoted from our Report, p. 210, and that was provided with a conductor of the same bad pattern as the one that failed recently at Chichester steeple, and which a gentleman thought it desirable to bolster up in *The Times.* The total sectional area of metal in the Caterham conductor was four-hundredths (0·04) of an inch—not as thick as a lead pencil, and it is no wonder that it failed. The next case is that of Brónó Church, Norway, Oct. 17, 1872. It had a lightning-rod of iron or zinc wire, which, however, was rusty at junction with ground. The stroke wholly destroyed the church. If people put up conductors and won't look after them, it is no wonder they come to grief. As to the case in Switzerland, if it had been quoted fully it would have stated that the subsoil is exceedingly dry, and that you can't get a good earth connection for the conductor. There is no damp soil, and the natural explanation of it is that the two *châlets,* which are said to have been defended by two conductors, had them led into dry earth, where they had bad earth connection and mischief occurred. They were actually in dry rock. In the case of the works of Messrs. W. Collier & Co., machine makers, Col. Parnell stated that there was an iron ring running round the top of the chimney, that the conductor was not connected with the ring as it should have been, but that it was brought down through the stonework. The result was a disruptive discharge. In the case of St. Mary's Church, Crompsall, Manchester, from the description read in full by Col. Parnell it seemed clear there was no earth-plate whatever. That was like putting up a rainwater pipe with no drain to carry off the water. At Kersal Moor, Manchester, the gas was ignited, but the gas mains and the conductor were not joined. In a case at Whitechapel where, we are told, the houses had the ordinary iron gutter and

pipe, but the lower portion was of wood, no wonder that damage ensued. Then comes the house of Mr. Osbaldiston—there again no connection with the gas main. With respect to Lichfield Vicarage we are told that there was a lightning conductor on one stack of chimneys, and that the other stack was struck: exactly so. The second stack would be outside the protecting area, the conductor was only run up one stack, instead of having short terminals run up each. There is, then, the Kew Bridge case, where the conductor was laid in dry earth. Then there is a case which at first sight looks bad, where we are told that the point of the rod melted and the building caught fire. For that reason the Conference, which sat on this matter, decided that the points should not be made extremely sharp, because it was thought there was just the slightest risk from that source. Then comes that Berne case, upon which the evidence is quite clear as to what was the matter. We are told that the ground was raised around the base of the rod, whose lower end showed traces of great heat. The rod was simply left to end in earth without any earth plate; consequently the resistance would be great and the point become hot. With respect to the protection suggested at the bottom of the chimney, I am not going to say that that is altogether a bad thing, but I infinitely prefer a conductor outside the house to coaxing the lightning inside the chimney. There is no doubt that the soot covering it and the hot air passing up it do act as a sort of temptation to the lightning to strike it. I think it would be found on inquiry that, of the chimneys struck, something like 70 or 80 per cent. are kitchen chimneys, the reason being that in our climate thunderstorms chiefly occur in summer, when it is very unusual to have a fire in any other room. When the lightning does come down the ordinary kitchen chimney, it finds itself, to a certain extent, in a sort of *cul de sac*; but as to the suggestion to put a couple of bars, 12 inches deep, into the dry earth under the kitchen fireplace--why, we should have them red hot, and the Berne accident specially arranged for. The Bruntcliffe powder magazine case, although it sounds awkward, was not so in any way whatever. It was a case of imperfect earth connection. The building was a barn-shaped sort of place entirely of brick, but with an iron door at one end. At the other end there was a sort of tall mast, and the conductor went up that mast and its base was laid into a drain, with no earth plate; and that drain, there is every reason to believe, from Messrs. Haigh & Son's letter [Report L. R. C., page 216], contained no water at all. Consequently, when the lightning was passing along, in order to get up or go down to the point, it met with a resistance, and jumped across the inside of the building at or from the iron door which ought to have been connected to the conductor. It was a case in which thorough electrical knowledge had not been brought to bear. Too often the neighbouring ironmonger or hardware man is sent for to "put up a conductor," and in that way not a few of the accidents charged to lightning conductors arise.

G. J. SYMONS.

[Remarks by Professor W. Grylls Adams, F.R.S.]

The Lightning-rod Conference,* of which I had the honour to be Chairman, consisted of members selected to represent Meteorology, Physics, Architecture and Electrical Engineering, and their report may be regarded as the summing-up of evidence, and reasonings based on

* See the *Report of the Lightning-rod Conference*, 8o. Lond. 1882.

evidence, of all accidents from lightning of which they could get complete and authentic accounts. Their report and the rules which they have recommended are no preconceived ideas of individual members, but are the results of a thorough discussion of all the evidence on the subject which they have been able to gather together, and may therefore be taken to be the concentrated teaching of the experience of the past. It is not surprising, then, to find that many of the instances of accidents from lightning, referred-to by Col. Parnell, are recorded or referred-to in this report of the Lightning-rod Conference. Mr. Symons has drawn attention to some of these. With regard to the church of Week St. Mary, in Cornwall, there has never been a lightning conductor on any part of the church, although the pinnacles of the tower have been struck no less than five times. On the last occasion, on November 8th, 1878, the electricity passed from the pinnacle by a leakage, where a stream of water ran between the granite facing and the interior masonry, to the top of a belfry light. The stream of water through and down the face of the wall formed a partial conductor, and no damage was done except where this stream was insufficient to carry the electric current. Where resistance was offered, granite blocks were scattered or broken, and the flash leaped by iron bars across windows and to the eaves of the roof of the church, from which it was carried off by rainwater pipes. Here the eaves-gutter and metal conductors clearly saved the church from further damage.

A lightning conductor attached to a building may prevent damage in two ways. It may draw away electricity from the clouds by the silent discharge, and so diminish or altogether prevent the lightning flash, or, if of sufficient capacity, it may carry off the lightning flash, and so prevent damage by offering the path of least resistance to the discharge. The sharper the point of a conductor the more readily will it tend to prevent the gathering of an electric charge in the atmosphere, by discharging negative electricity quietly from the earth; but when a violent discharge takes place, the sharp point may offer too great a resistance and so may be melted. To meet both cases, it would probably be better to have a blunt end for the upper terminal, but at the same time to have three or four sharp points just below the top, to prevent a heavy charge from gathering. Sharp points could not be relied on in cases where clouds carried by the wind approach the conductor very rapidly, and give a heavy discharge; and in such cases one side of a building may suffer, even when there is a conductor on another part of the building. Let me refer to a few cases of accidents reported by architects to Professor Hayter Lewis and Mr. Whichcord, and referred-to on page 27 of our Report. Of thirty-three cases here reported of damage to buildings, there were only six cases in which the buildings injured had lightning conductors. If we look more particularly into these six cases, we find that, in one of them (at All Saints' Church, Nottingham), the lightning broke through the wall, 4 feet 6 inches thick, at a height of 6 feet from the floor to a gas pipe, because the lower part of the conductor had been stolen. This case is quite sufficient to show the value of a lightning conductor. Here the gas pipe offered to the lightning the path of least resistance between the clouds and the earth.

In another case, the conductor was of wire rope, and was bent about awkwardly under copings and sharply around mouldings, and the only damage done was to projections of mouldings, close to a bend in the conductor, about 20 feet from the ground. In this case the conductor from the weathercock passed down inside the spire and out at the belfry window, and yet in these parts the conductor carried off the charge without damage.

In another of these six cases, at Twyford Moors, near Winchester, a building was struck at a point 64 feet away from the lightning conductor, and only 16 feet below the upper terminal. This was clearly a case where there was not sufficient protection offered by the lightning conductor. If we draw a line from the top of the lightning conductor to the point struck, the inclination to the horizon is only about 14 degrees. Now, no lightning conductor can be expected to protect the space within a cone, of which the diameter of the base is eight times its height. Even in this case, the conductor had previously carried off so much of the electricity by the silent discharge, that very little damage was done, only a few tiles and laths being displaced. The question as to the area protected by a lightning conductor in perfect order is one about which there is still considerable doubt; but with the exception of two instances, about which the facts are not clearly recorded, there is no recorded instance of a building being struck by lightning within a conical space, the radius of whose base was equal to its height. On this point a remarkable case is reported from Finsbury. The top of a flagstaff on the tower of the church of St. Giles's, Cripplegate, was struck; the charge descended and shattered the *upper part* of the wet wooden pole, and then flew across to the summit of the copper conductor, leaving the tower and even the *lower part* of the flagstaff unhurt. We may form some idea of the damage which would probably have been done in this case if there had been no conductor, by comparing with it a case at Gravesend, where a chimney, 40 feet high and without a conductor, was completely destroyed down to the eaves-gutters, and the bricks scattered over a radius of 200 feet; but not a brick was disturbed below the eaves-gutters, because the rainwater pipes carried off the charge.

In two other of the six cases above referred-to, gas pipes helped to carry off the charge, but melted and set fire to the building; the lightning conductor, the eaves-gutter, and the leaden gas pipe, in one of these cases, being in metallic connection, the damage to the building was done, not by the lightning but by the burning gas. We see then that when damage is done to buildings where there is a lightning conductor, it is because the lightning conductor has not been properly placed. I will only mention one other case, which is taken by Col. Parnell from our Report (p. 210): an accident at the house of Mr. Tomes, of Upwood Gorse, Caterham. The conductor is a copper tube screwed into a collar connected to a woven band of 1 zinc and 13 copper wires, carried down into 12 inches of dry chalk. The rod was broken at the point where the area was reduced by the screw cut into it for the collar, and the thread of the screw was melted. The zinc wire had probably been wasted by galvanic action, for with zinc and copper wires there would only be a little moisture required, which our climate readily supplies, to convert the conductor into a Daniell's battery. The bottom of this so-called conductor was carried into 12 inches of dry chalk, and therefore there was no proper earth connection.

It is not necessary that I should refer further to accidents from lightning flashes. I trust that the cases I have taken have clearly shown that the effects of lightning discharges may be very serious when there is no proper lightning conductor. Col. Parnell prefers to say that the lightning discharge starts from the earth and goes up to the clouds, whereas it is usual to speak of the lightning as coming down from the clouds to the earth. In order to be scientifically exact we must go back to the experiments of Sir Charles Wheatstone on the discharge from a Leyden battery: he showed that the discharge begins at the same instant at

the two coatings and meets somewhere in the middle of the conducting wire. Hence we may expect that the charge would start from the clouds and from the earth at the same time, and that the middle point (or break of greatest resistance) between them will be the point last reached by the lightning discharge. That point may possibly be within the building and near the top, or in some cases near the bottom of it.

There is one other point to which I will refer which bears upon Col. Parnell's theory: When an electric discharge passes through a thick card, there is an apparent bursting of the substance outwards on both sides of the card; hence it must not be concluded, because there is an apparent bursting upwards of stones or metals struck by a lightning flash, that the electricity passes upwards from the earth to the clouds. Again, if clocks and bells are in very great danger of being struck, and if it is true that the smaller the building the more it requires protection, then the danger will be increased if the clocks and bells are put into low buildings, and so it would be necessary to do away with them altogether. I trust that the theory is wrong which demands so great a sacrifice.

W. GRYLLS ADAMS.

VI.—A BRIEF REVIEW OF THE EDUCATION AND POSITION OF ARCHITECTS IN FRANCE SINCE THE YEAR 1671.

By William H. White, *Secretary.*

[Read on Monday, 4th February 1884, Horace Jones, *President*, in the Chair.]

THOUGH much had already been done to establish academies in France before Colbert became Minister of State, he is always regarded as the original protector, if not the founder, of that academic system,* which, inaugurated during the reign of Louis XIII., has passed scatheless through periods of monarchical discredit, general confiscation, and revolutionary tumult; has been overturned for a moment; has been set up again by the Nation, consolidated by successive reforms under different political administrations, and recently developed by wise and generous measures. To Colbert, who was a member of the French Academy, is fairly due the original establishment of the Academy of Inscriptions and the Academy of Sciences. It was he who also persuaded Louis XIV. to purchase a palace in Rome for the reception of premiated students of painting, sculpture and architecture, and it was he who established, in 1671, the Academy of Architecture, at first composed of François Blondel, Levau, Gittard, Antoine Lepautre, Bruand, Dorbay, Mignard, and André Félibien.

The story of its rise is not devoid of interest, and to the events of the year 1665, celebrated in our architectural annals for the meeting between the Italian, Bernini, and Sir Christopher Wren, may possibly be due its formal establishment as an institution distinct from that representing the cognate, and once-subordinate, arts of painting and sculpture. In that year the King personally interested himself in the alteration and reconstruction of the old Château du Louvre, and his Minister, Colbert, who was also the Superintendent-General of the King's Buildings, devized scheme upon scheme to satisfy the whim or please the taste of his royal master. For this purpose Bernini had been summoned by the King to Paris, and treated like a prince, much to the disgust of those Frenchmen who, like Dr. Claude Perrault, had designs for the Louvre ready for execution, and much to the annoyance of Colbert whose opinions and inclinations in this matter are charmingly described by his Secretary, M. Charles Perrault, the brother of the architect of the famous Colonnade. A letter, written in 1665, by Wren, who was in Paris at the time, refers to this great building, which, says he, "was my daily object, where no less than a thousand hands are constantly "employed on the works, some in laying mighty foundations; some in raising the storeys, "columns, entablements, &c. with vast stones, by great and useful engines; others in carving, "inlaying of marbles, plaistering, painting, gilding, &c., which altogether make a School "of Architecture, the best probably, at this day, in Europe." Then he describes Colbert who, says he, "comes to the works of the Louvre every Wednesday, and, if business hinders "not, Thursday. The workmen are paid every Sunday duly." Wren was introduced to

* The French Academy *(l'Académie française)* was instituted in 1635 under Cardinal Richelieu, and the Academy of Painting & Sculpture in 1648 under Cardinal Mazarin.—W. H. W.

the acquaintance of Bernini, who showed him his design for the Louvre, a design which "I "would have given my skin for," he continues, "but the old reserved Italian gave me but a "few minutes view; it was five little designs on paper, for which he hath received as many "thousand pistoles; I had only time to copy it in my fancy and memory; I shall be able "by discourse and a crayon to give you a tolerable account of it." But this design was never executed, for Bernini, shrewdly seeing how matters stood, and magnificently compensated in pocket, left Paris on the plea that he wished to pass the winter in his native country. Colbert, thus rid of an incubus, obtained two new designs which he submitted to the King: one by Levau, the architect, and another by Perrault, a physician. The Minister, invited by the royal command, to select one of the two, chose that of Levau, whereupon the King ordered the other to be put in execution, and Dr. Perrault was intrusted with the work. But, nevertheless, it seemed strange to Colbert to prefer, in a matter of architecture, the "thoughts" of a physician to the "designs" of the most celebrated of architects, and here the wit of the Secretary of Works is conspicuous. He had his brother's thoughts put into the substantial shape of a model, and he wrote a report to H.M. Superintendent-General in which he suggested the appointment of a Building committee to carry out the proposed façade. The report was adopted, and the committee appointed. Lebrun, who combined the three arts, Levau, the most celebrated of architects, and Claude Perrault, the physician were members, with Colbert as Chairman, and Charles Perrault as Secretary. This committee, formed to superintend the execution of the Colonnade of the Louvre, grew into the Royal Academy of Architecture—a body of professional experts which, founded in 1671, incorporated in 1717 and again in 1776, suppressed with all the other academies in 1793, and re-established two years afterwards as a part of the National Institute of France, is still as useful as it is powerful, partly as a section of the Academy (one of the five Academies composing the Institute), and partly as the third section of the School, of Fine Arts.

The Academy was afterwards strengthened by the addition of Claude Perrault, Jules-Hardouin Mansart, Le Nostre, La Motte-Coquart and others, who bore the distinction of *architectes du Roi*, among whom was Desgodetz. The Academicians were all notable men. For instance: (1) Levau was the architect of numerous great houses, the principal of which was the residence of the Minister Fouquet, the famous Palace of Vaux on which he expended eighteen millions of francs, a sum of money declared by Voltaire to be equal in his time (a hundred years afterwards) to 36 millions of francs, namely £1,440,000 English. (2) Libéral Bruand was the architect of the Church of the Invalides, which the younger Mansart spoilt when he built the beautiful dome that now covers the tomb of Napoleon. (3) Daniel Gittard is known by churches such as that of the Oratoire, by the Hospice des Enfants-trouvés and other buildings in Paris, and many unexecuted designs of his have been engraved by Jean Marot. (4) Antoine Lepautre was the architect of the Hôtel de Beauvais, which still exists at No. 68, Rue François-Miron, Paris. He is also known as the first in France who arranged shops on the ground storey of large private residences in such a manner as not to interfere or be connected with the apartments over, and he was the younger brother of the engraver, Jean Lepautre, whose drawings of decorative subjects are well known. (5) Pierre Mignard, brother of the painter, and a painter himself, was led to study and practise architecture from the circumstance of having been employed in Italy

to make drawings of the great works of antiquity. (6) Dorbay, a pupil of Levau, was the architect of the Collège des Quatre Nations, better known as the Collège Mazarin, under the dome of which the Institute of France now holds its meetings. (7) Jules-Hardouin Mansart was the nephew of *the* Mansart, and an architect who, described by his contemporaries as devoid of genius, nevertheless built the dome of the Invalides and the chapel of Versailles, two works which the late Marquis de Laborde described as "deux inspirations qui suffisent "à la gloire d'un homme;" (8) François Blondel was the architect of the Porte Saint-Denis, and the author of the *Cours d'architecture* first published in 1675. He was professor and director of the Academy of Architecture, a member of the Academy of Sciences, and master in mathematics to the Dauphin. (9) Claude Perrault, generally described as one who from being an ignorant physician became a good architect, was the architect of the Colonnade of the Louvre. He was also the author of the first learned version in French of Vitruvius which was made by Colbert's order and published in 1673. (10) Le Nostre is still famous for the marvels he created at Versailles and at other royal residences. (11) La Motte-Coquart, *Officier des Bâtiments,* is said to have been admitted an academician by favour. (12) Desgodetz is best known as the author of the work, *Les édifices antiques de Rome,* which was first published in 1682. He was sent by Colbert as early as 1674 to Rome, to measure and draw the finest buildings existing there, and on his way was taken prisoner by Turks, conveyed to Algiers, and thus considerably delayed in his mission. He was also professor of architecture and his *Cours* consisting of a series of lectures in two parts, one on the Orders and the other on their application, is preserved in our Library. The manuscript, written in a clear round hand, was presented, in January 1842, by Guénepin, a member of the Academy of Fine Arts, who was also an Hon. Corresponding Member of our body. (13) André Félibien was appointed Secretary, and "kept the register of the Academy of Architecture." He is remembered by his principal work, published in 1676, entitled *Des principes de l'Architecture,* to which is added a valuable glossary of technical terms.

The first address to the Academy of Architecture, delivered on the 31st December 1671 by Blondel, has been inserted by him as an introduction to his *Cours,* the publication of which, begun in 1675, was completed in 1683. The address contains one or two salient passages to which I must allude. Seeing, said he in effect, that the King has chosen you, from among those who practise the profession of architecture, as the most capable to give this art the perfection which is wanting to it, do you not think, as a response in some sort to the honour conferred upon you, that there are no books treating of this subject which you ought not to read more than once, no drawings of ancient or modern buildings upon which you ought not to meditate, no time nor care that you ought not to be obliged to employ, in order to form in your minds the veritable and perfect idea of architecture? and he continues: "Can we doubt, gentlemen, the love that this prince has for architecture when we consider "how, in the charge of his buildings, he has chosen that same genius (Colbert) to whom he "intrusts so advantageously the most important affairs of State?" "Let us work then, "gentlemen, under such illustrious protection, and render ourselves worthy of the employ to "which His Majesty has called us. Let us confer together in good faith, and communicate "our thoughts for the development of architecture. For it is true that it suffices not to have "a medium acquaintance with the rules of this excellent art in order to be veritably an

"architect; and that this quality demands the co-operation of so many virtues and different "attainments that a life-time is insufficient to acquire it." The whole address is a charming piece of composition. In the preface which precedes it Blondel refers to the King's intentions with regard to the Academy, and states that his *Cours* was written for the purposes of instruction within the Royal Academy of Architecture. His Majesty, he says, wished the academicians to meet once a week for the purpose of conferring with one another, and he commanded that a register should be kept of the Conferences, in which the principal difficulties encountered in the construction of buildings should be discussed and solved. His Majesty also wished that the sound principles and most correct rules of architecture should be publicly taught two days a week, in order that a nursery, so to speak, of young architects might be formed; and to give them more courage and passion for the art, the King ordered that, from time to time, prizes should be given to those who succeeded best, promising that a certain number of the young men so premiated should be sent immediately at the royal cost to Rome, in order that nothing might be wanting on the King's part to complete their education, and render them fit to act in the conduct and superintendence of the royal buildings. At the same time he commanded that, during the second hour of the public lectures, those sciences which are absolutely necessary to an architect, such as geometry, arithmetic, mechanics, fortification, perspective, stereotomy,* and other portions of mathematics, should also be taught; and what was understood, in those days, to be included in the science of architecture, may be judged by referring to Blondel's course of lectures, in our Library. These consist of four parts, making two thick folio volumes, profusely illustrated. Many British students have no doubt looked at their outsides, and a few who have opened them, seeing engravings of the five Orders, with apparently tedious explanations in unfamiliar characters, have concluded, with inexcusable rashness, that the books were merely foreign translations of Vitruvius, and that to skim that author in the English of Gwilt was as much as a classical student could be expected to do, and much more, I make bold to say, than many a living disciple of Pugin has ever done. Nevertheless, when it is remembered in what the literature of France and England consisted during the latter half of the seventeenth century, when the idea is realized of what the library of a private gentleman must have contained in those days—what the intellectual condition of the great mass of mankind then was in the different countries of Europe—it is impossible, in my opinion, to regard the literary performances of Blondel, Perrault, Desgodetz, Félibien and their contemporaries of less note, with other than sentiments of admiration and humility.

Indeed, I do not hesitate to assume that the acknowledged excellence of many of the royal and public buildings executed throughout France during the seventeenth and eighteenth centuries is largely due to the precepts taught, the information supplied, and the inquiries instituted, by the Academy of Architecture. It is also largely due to the wise and judicious control exercised by successive Ministers of State over the deliberations and works of the Academy, and to the confidence, so happily inaugurated by Colbert, which existed between the Academy of Architecture and the State. Nowhere is this better shown than in the order to Perrault to undertake a translation of Vitruvius, in the despatch of Desgodetz to Rome to

* Stereotomy, described in Weale's *Dictionary of Terms*, as the "art of cutting solids, or making sections "thereof, as walls or other members in profile of architecture"; described in Littré's *Dictionnaire de la langue française*, thus, —"Stéréotomie, science qui traite de la coupe des solides, charpente, pierres, &c."

measure the antique monuments, in the demand made on the Academy to report on the source and quality of the stones used in the old churches and other buildings of Paris and its environs. This last was a memorable task. On the 12th July 1678, Charles Perrault, who was then Controller of Buildings, presented himself at the Academy, and in Colbert's name requested the architects to visit without delay all the quarries whence the principal building-stones were obtained, and to report thereon, as well as on the various stones used in the most important buildings around and within the capital. The academicians began work the next day, and a copy of their report, drawn up by André Félibien, entered in the Minutes of the Academy (Vol. I., fol. 257), is preserved in the National Library of Paris. Each day's work is carefully noted, and the last record appears to be on the 22nd September 1678. The report was finished on the 10th April 1679. Some 125 buildings, monuments and quarries were visited, examined and reported on. When, in 1852, the late Marquis (then Count) de Laborde prepared an analysis of this report, which is printed in Vol. X. of the *Revue de l'Architecture et des travaux publics* (founded and conducted by our distinguished Corresponding Member, M. César Daly), he took occasion to obtain a series of notes from three experts, in order to test the value of the examination made by the Academy of the various building-stones, and of the opinions expressed thereon by it in 1678. "Since that period," writes one, namely, the late M. Viollet-le-Duc, "time has only confirmed the exactness of the observations made in the "Academicians' Report."*

The relations between the Royal Academy of Architecture in Paris and the Academy of France at Rome were not officially recognized until many years after the foundation of the former. The late M. Victor Baltard's work, published in 1847, entitled the *Villa Médicis*, gives the name of every student or *pensionnaire* admitted into the Academy at Rome, the first suggestion for which was made by Lebrun, the pupil of Poussin, both of whom had lived in Italy. The Academy was founded in 1666, when Errard, President of the Academy of Painting and Sculpture, was appointed President of the Academy of France at Rome, and started for the Eternal City on the 6th of March of that year, with twelve students of painting and sculpture. They established themselves in the Capranica Palace, and lived there at the cost of the King. Seventy years later, his successor, Louis XV., gave orders for the acquisition of the Mancini Palace, and the Academy remained in that building until 1803, when it was transferred to the Villa Médicis, where it is still housed. From the year 1666 until the present time a student of painting has been sent to Rome, and, with almost equal regularity, a student of sculpture has accompanied him. But, during no part of the seventeenth century, is there any record of an architect-student, nor, until the year 1720, can the *grand prix* in architecture be said to have existed. Three years previously, in February 1717, letters-patent had been granted to the Academy by the Duke d'Antin, who was then Superintendent of the King's Buildings and Minister of State. The Academy was formally incorporated, and the number of members was increased to twenty-four, viz.: in the first class, ten architects,

* See the *Revue de l'Architecture, &c.*, vol. x., col. 204, in which he states that, "All the stones then recog-"nized as defective have more and more deteriorated; those which had at that time resisted atmospheric "influences are still intact at the present day. This proves," continues Viollet-le-Duc, "that stone, once fixed, "hardly ever fails to immediately disclose its character; defective stones rapidly betray symptoms of decay, "and those which in the first instance are proof against atmospheric agencies of destruction acquire illimitable "powers of duration."—W. H. W.

one professor and one secretary; in the second, twelve architects. During the fifty-nine years which elapsed between this incorporation and the presentation of other letters-patent in 1776, three men had filled the office of registrar or secretary: the Abbé Prévost in 1702, a geometrician or surveyor named Camus in 1733, and a dramatic author named Sedaine in 1768. During the earlier portion of that period, the prevailing architecture included all the worst features of the style or fashion which is now known as "Louis Quinze"—features, though which were introduced during the reign of Louis XIV. Indeed, a generation of *Rococo* had come, and was well-nigh worn out, when, midway in the eighteenth century, Voltaire wrote his stirring article, entitled "*Des Embellissements de Paris.*" Read between the lines, it serves to show that H.M. Office of Works no longer experienced the smooth, strong influence that Colbert, and his son after him, exercised; and it conveys so good a moral that I will ask permission to read an extract from it, merely warning the younger Members of the Institute to take heed that they do not confound a description of Paris in 1749 with the London of our own advanced era of civilization and art. "We possess," wrote Voltaire, "the where- "withal to purchase kingdoms; we see every day what is wanting to our Capital, and we content "ourselves with murmuring. . . . . We rush to the theatres and are indignant on entering "them in a manner so inconvenient and so disgusting, to be so uncomfortably seated there, and "to leave them with more trouble and confusion than when we entered. We blush, rightly, to "behold public markets established in narrow streets, spreading dirt and infection. We have "only two fountains in good taste, and they are far from being advantageously situated; all "the others are worthy of a village. Immense districts require open spaces, and the centre of "the town, obscure, confined, hideous, represents a period of the most shameful barbarism. "We say this without ceasing, but until when shall we say it without remedying it? . . . . "The meanness of ideas, the fear, still more mean, of a necessary expenditure, rise up to "contend with those projects of grandeur which every good citizen has made to himself a "hundred times. We are discouraged on thinking what it will cost to raise these necessary "monuments, the greater number of which, becoming every day indispensable, must be executed "in the end, whatever they may cost, though in the main it is very certain that they will cost "nothing to the State. . . . What! Shall it be only at the last extremity that we do something "great? If half Paris were burnt down we should rebuild it, rendering it superb and "commodious; and we are not willing to give it, to-day, at a thousand times less cost, the "accommodation and magnificence which it needs! Yet a similar enterprise would redound to "the glory of the nation, would be an immortal honour to the municipality, would encourage "all the arts, and, far from impoverishing, would enrich the State. It would moreover "accustom to work a thousand worthless loafers, who sustain a miserable life on the infamous "trade of begging, and who still contribute to dishonour our Capital. . . . . . May "Heaven send some man, some Statesman, sufficiently zealous to undertake such projects, "with a mind sufficiently firm and enlightened to carry them out; and that he may have "trust enough reposed in him to make them a success! If in our immense city no one can be "found to do this; if we are contented to talk of it at table, to utter useless vows or maybe "impertinent pleasantries, *il faut pleurer sur les ruines de Jerusalem.*"

Nevertheless, at that moment, the architects were neither unskilful nor inactive, though perhaps the style of design still in fashion was overburdened with misplaced ornament.

Noblemen's residences were then invariably carried out by architects, and the designs of Gabriel, made for the Place Louis XV., now called the Place de la Concorde, which were approved by the King in 1753, show that the Academy was teaching and practising a purer adaptation of ancient architecture than it had hitherto done. About that time David-Leroy, who was a student of the Academy of France at Rome in 1751, visited Greece, and his celebrated work, which excited so much controversy, entitled *Les Ruines des plus beaux Monuments de la Grèce,* was published in 1758.*

The fresh letters-patent, presented in 1775 to the Academy of Architecture, and registered in Parliament in January of the following year, declared that the company should be composed of academicians who should be architects; of honorary associates† who should be non-professional; and of correspondents or associates, both native and foreign. The academicians were, as before, to be divided into two classes, each of sixteen members; the honorary associates were to be sixteen in number, chosen from among persons who, without professing architecture, were distinguished by their knowledge of the art, or those arts relating thereto; and the rank allotted to them was between the first and second class of academicians. The correspondents were to be twelve in number, chosen from among foreign artists and others not resident in Paris, or within at least fifty miles of the capital.

A great deal of information respecting the action and work of the Royal Academy of Architecture in the last century may be found in J. F. Blondel's *Cours,* printed in the *Architecture françoise,* edited by Patte,‡ the author of *Monuments érigés en France à la gloire de Louis XV.,* fo. *Paris,* 1767, and of *Mémoires sur les objets les plus importants de l'architecture,* 4to. *Paris,* 1769. Gabriel was a member of the Academy, and the Blondel just mentioned was Professor of Architecture there early in the latter half of the eighteenth century. In 1791 David-Leroy was also one. The academicians, who were all *architectes du roi,* appear just before their suppression to have been 40 in number, and to have had under their charge an equal number of students, a fact which was recalled by Louis Pierre Baltard in a Paper he read to the Academy of the Fine Arts about the year 1820.

The Revolution, which suppressed all the Academies, served to retard, but only retard, the development of French supremacy in the arts, for happily many of the institutions then abolished were re-established. On the 22nd of August 1795, the National Institute of Science and Art was founded by a decree of the Republic. On the 25th of October it was declared to belong to the whole Republic, and destined (1) to improve science and art by uninterrupted research, the publication of new discoveries, and correspondence with learned societies abroad; (2) to follow, in conformity with the decrees of the *Directoire,* scientific and literary labours of general utility. It was to be composed of 144 members residing in Paris, and 144 associates scattered over different parts of France, while the number of foreign associates was to be 24: that is to say, eight for each of the three classes in which the National Institute was divided. These classes were (1) Physical and Mathematical science, comprizing 60 members and

* The first volume of Stuart and Revett's work appeared four years afterwards, in 1762.

† See the *Dict. de l'Académie des Beaux-arts,* article "Académie d'Architecture," page 98, in which it is stated that—"Les honoraires associés libres sont au nombre de seize, choisi parmi les citoyens qui, sans professer "l'architecture, se seraient distingués par leur connaissance dans cet art ou ceux qui lui sont relatifs."—W. H.W.

‡ This distinguished Professor records, with pride, that in his time, in St. Petersburg, Berlin, Copenhagen, Munich, Stuttgart, Mannheim, Madrid and Parma, the principal architect is a Frenchman.—W. H. W.

60 associates; (2) Moral and Political science, comprizing 36 members and 36 associates; (3) Literature and the Fine arts, comprizing 48 members and 48 associates. The Collège Mazarin was assigned to the Institute. Every year the Legislature would grant a sum of money for the maintenance of the Institute and the prosecution of its work, and 26 citizens were to be annually chosen in competition to travel for a term of years; and all this at the cost of the Republic. The *Palais national*, at Rome, already occupied by French students of painting, sculpture and architecture, was to be preserved and used as originally intended. Its Chief, nominated for a term of six years, was, as formerly, to be a French painter who had previously resided in Italy. Students designated by the Institute were to be annually sent to Rome, where they would be lodged and boarded for five years at the cost of the Republic, and their travelling expenses paid; while, further, the Institute was every year to publicly distribute several prizes. Fresh duties were intrusted to it on the 13th of December 1799, and, among other additions, eight professors of music and musical composition were appointed. Moreover, no French federation was to henceforth bear the name of "*Institut*" except this same National Institute of Science and Art—an order which has been carried out to the letter.

Each of the three classes of which it was composed in 1795 met separately at regulated intervals, and they held in common four public meetings a year. Each class published its transactions annually, and the three, combined under the title of Institute, submitted an annual report to the Legislature on the progress of the sciences and the arts. At that time the Institute awarded six prizes, two in each class, and presented them at one of the public meetings of the whole body. When a work of importance and merit appeared, the Institute reported upon it to the Legislature, and made a recommendation respecting it. Every year the three sections of painting, sculpture and architecture (III. Class of Literature and Fine Arts) assembled, and selected the artists whom the Institute was commissioned to designate for five years' residence and study at Rome. A committee of six members, two nominated by each class and elected annually, were intrusted with the superintendence of its affairs, and reported annually to the general body.

Passing over the decree of the Consulate in 1803, whereby the Institute was divided into four instead of three classes, and the class of Moral and Political science abolished, I will come at once to the statute of Louis XVIII., dated the 21st of March 1816, when the Institute was remodelled, and the Academies were reinstated in the order of their foundation, namely, the *Académie française*, the *Académie royale des inscriptions et belles-lettres*, the *Académie royale des sciences* and the *Académie royale des beaux-arts*. By this re-organization each Academy, a term for which the first Republic had needlessly substituted the word "Class," was allowed independent action and free disposal of the funds specially granted to it by the State; but the Secretariat, the Library and other collections of the Institute remained common to all the Academies. Their property was controlled and administered under the authority of the Home Minister by a Committee of eight members, of whom two were annually elected from each Academy. Six years later, Louis-Philippe reinstated the *Académie des sciences morales et politiques* as the fifth Academy composing the Institute; and since then, though modifications of an unimportant nature have occurred, the Institut de France has consisted of five Academies, housed in the Palais de l'Institut, originally the Collège Mazarin, which contains the splendid Mazarine library and collection. The Academy of Fine

Arts, divided into five sections, is composed of 14 painters, 8 sculptors, 8 architects, 4 engravers and 6 musical composers, with 10 *Académiciens libres,* all Frenchmen; 10 *associés étrangers,* and a permanent secretary. It has also corresponding members, equalling the academicians in number, who are divided into six sections, composed of Frenchmen and foreigners, namely: 14 painters, 8 sculptors, 8 architects, 4 engravers, 6 musical composers and 10 *correspondants libres.* Among the foreign associates of the Academy are Mr. J. E. Millais, R.A., painter, and Professor Donaldson. Among the foreign correspondents are three painters, Mr. J. R. Herbert, R.A., Sir Frederic Leighton, P.R.A., and Mr. L. Alma-Tadema, R.A.; one English composer, Sir Julius Benedict; and two English *correspondants libres,* Professor C. T. Newton, C.B., and Sir Richard Wallace.

The architect-academicians, *membres de l'Institut,* are MM. Questel, Ballu (entered at Rome in 1840), Garnier (entered at Rome in 1848), Abadie, Bailly, Vaudremer, and Ginain (entered at Rome in 1852). One other architect, M. Albert Lenoir, is an honorary academician. The French corresponding members are MM. Morey (entered at Rome in 1831), of Nancy, and Révoil, of Nîmes, both architects; and M. Marionneau, of Bordeaux. With the exception of the two recently elected academicians, all the architects of the French Academy of Fine Arts are corresponding members of our body, and I think it is generally admitted that they honour their British *confrères* by accepting the distinction which the latter are enabled to confer. MM. Morey and Révoil are also correspondents of our body. Indeed, had the Fates been less unpropitious, I could have mentioned two others similarly connected with us,—Lesueur,* who died on Christmas Day last, and Chenavard who died a few days afterwards. Lesueur (entered at Rome in 1819) was elected an Academician in 1846, and received the Queen's Gold Medal in 1861; Chenavard,† of Lyon, was a corresponding member of the Academy, and the father, by right of age, of the French architects.

After the suppression of the Academy of Architecture, whereby the youth of the profession was left without instructors, individual efforts were made to establish a school or studio; a semi-private *atelier* was conducted by David-Leroy, A. L. T. Vaudoyer, and L. P. Baltard. To these distinguished professors our French brethren owe, in my opinion, a heavy debt of gratitude. They held the threads of academical tradition from 1789 to 1816. Vaudoyer's proposal for a National School suggested the establishment of six professorships; he divided instruction in architecture into six heads, namely:—

1.—Elementary. Comparison of buildings one with another, and in regard to the principles of composition. Application of the said principles developed in designs to be made by the students.

2.—The architecture of different peoples historically considered. Inquiry into the beauty and proportions of antique monuments. The study of ancient authors and *grande* composition.

3.—Construction. Study of the construction of different nations, of that peculiar to the ancients, their methods and materials compared with our own. Experiments from nature, and demonstration upon the monuments themselves.

* Since this Paper was read, the Chair of Lesueur at the Academy of Fine Arts has been filled by the election of M. André, who won the honours of Rome in 1847, and who has since distinguished himself in the practice of architecture.—W. H. W.

† The place of Chenavard has been recently filled by the election of M. Henri Duphot, architect, of Bordeaux, as *correspondant de l'Institut.*—W. H. W.

4.—Perspective. Development of the proportion of monuments of architecture from different points of view; simple and abridged method of rendering account by perspective of those different compositions, and practical lessons to students, who will work during this course under the direction of the professor in *salles* arranged for this purpose.

5.—Mathematics. Application of mathematics to the art of building, to that of taking plans by trigonometry.

6.—Stereotomy, &c.

In course of time, the government, recognizing the necessity of possessing some central institution in which architecture could be taught, set apart certain rooms for the instruction of students in architecture in the Collège Mazarin, otherwise known as the Collège des quatre Nations, where at the time the competitions for the *grands prix de Rome* used to take place, and the meetings of the National Institute were also held. The Ecole des Beaux-arts may be said to date its existence from this period—the beginning of the present century—and under the immediate control of the National Institute. When, in 1816, the Royal Academies were restored, and grouped under the same comprehensive head of National Institute, a site was found for the future School of Fine arts on land then partly covered by a mediæval convent, which contained the celebrated Museum of French Monuments, collected and controlled by Alexandre Lenoir, the father of the present distinguished Secretary of the School of the Fine Arts, M. Albert Lenoir, whose valuable letter on the subject of the rise of the School, which he was good enough to write in reply to my inquiries, I beg leave to communicate, as follows:—

Notre école est l'héritière d'une partie des dispositions de l'ancienne Académie de Peinture et de Sculpture crée en 1648 par les plus habiles artistes du siècle de Louis XIV, puis de celle de l'Architecture qui datait de 1671, l'une et l'autre approuvées par ordonnance du Roi. L'Académie de France à Rome fut fondée à la même époque. Le 8 Août 1793 ces académies furent supprimées par un décret de la Convention Nationale, mais comme l'étude des arts était menacée de destruction par cette mesure, le 28 Septembre 1793 il fut décrété que tous les membres des sections de peinture et de sculpture chargés de la direction des études continueraient leur service à une école publique qui fut nommée *École des Arts*. Les autres professeurs furent supprimés ainsi que leur directeur. Le 30 Frimaire de l'an XIV de la République, M. de Champagny, Ministre de l'Intérieur, fit cesser, par un arrêté, l'état provisoire de l'École, pour l'organisation de laquelle plusieurs projets avaient été proposés sans résultat. Par cette arrêté les professeurs enseignants devaient être au nombre de douze, six peintres et six sculpteurs, et les recteurs ne devaient être qu'au nombre de quatre, et n'arriver à cette place qu'à l'âge de 70 ans. Cet arrêté n'a pas eu d'exécution entière, les professeurs n'ayant été qu'au nombre de huit.

L'étude de l'architecture, abandonnée par l'État, resta pendant plusieurs années dans l'oubli, et les élèves dispersés étaient sans guides, lorsque M. David-le-Roy, architecte, auteur d'un ouvrage produit par ses études en Grèce, recueillit quelques jeunes gens qui se trouvaient sans encouragement, sans concours, sans local. Le 24 Pluviose, an XI, M. Vaudoyer père avait fait un projet d'école d'architecture ; il se joignit à M. David-le-Roy, ils appelèrent quelques artistes, M. Baltard et autres, pour donner des programmes, juger les concours ; les prix adjugés aux élèves furent distribués aux frais des professeurs.

L'École d'Architecture, se développant sous cette influence, fut établie dans les salles du rez-de-chaussée de la grande cour de l'Institut, ancien Collège Mazarin, et les concours du prix de Rome avaient lieu dans les combles des bâtiments de la même cour.

Le 18 Décembre 1816, le roi Louis XVIII affecta à l'École des Beaux-Arts l'ancien local du Couvent des Petits Augustins de la Reine Marguerite, situé rue des Petits Augustins, aujourd'hui rue Bonaparte, faubourg Saint-Germain, monastère dans lequel, dès l'année 1790, Alexandre Lenoir, mon père, avait fondé le célèbre Musée des Monuments français, collection précieuse, formée par lui de tous les tombeaux de nos rois et des princes, de ceux des grands hommes, et des monuments de l'art national qu'il avait pu arracher à la hâche révolutionnaire. M. Debret, architecte du Gouvernement, et depuis membre de l'Institut, fut chargé de commencer les travaux d'installation de la nouvelle École ; le Musée des Monuments français avait été supprimé par ordonnance du Roi en date du 14 Avril 1816, et les principaux monuments

enlevés dès 1817. M. Debret établit des amphithéâtres de cours et d'étude dans les anciennes salles du Musée, construisit un bâtiment pour les concours mensuels et pour ceux de Rome, et dans l'ancien jardin du Musée il éleva l'aile méridionale du palais des études ; l'édifice en était arrivé à ce point lorsque M. Félix Duban, beau-frère de M. Debret, eu la mission de compléter ce monument, et de construire les amphithéâtres définitifs et toutes les dépendances nécessaires à une grande École.

The ordinance of Louis XVIII., dated 4th August 1819, which determined the rules of the new School, intrusted it to the charge of the Professors, who formed a "general assembly," the decisions of which were executed by a President, a Vice-President, an immediate Past-President, the permanent Secretary, and one of the Professors in the Section of Architecture. These composed an administrative Council. Though the School was a State-institution, the responsible Minister of the Crown had no voice in its management, the general assembly of professors being sole and absolute judges of everything connected with it. The influence of the Academy, it may readily be conceived, was powerful under such circumstances, and paramount to that of the State.

The change effected by the re-organization of 1864 was a most important one, for it virtually separated the *School* from the *Academy* of the Fine Arts. It set up the School as an independent institution under the immediate control of the State, and answerable to the Government for its acts. Napoleon III. placed the administration of the School under the charge of a Director, to be nominated for five years, with an office composed of a secretary, an accountant, a keeper and a librarian; and the educational staff consisted of professors intrusted with the various courses of instruction, and of professors at the head of the different studios. The Imperial decree constituted a council composed of the Superintendent of the Fine Arts, president; the Director of the Administration of the Fine Arts, vice-president; two painters; two sculptors; two architects; one engraver, and five other members. All these were appointed by the Minister, and a third of the Council, excluding the president and vice-president, retired annually, but were eligible for re-election. The adjudication of the designs submitted for the *grands prix de Rome* was then first taken out of the hands of the Academy, and delegated to juries pertaining to the School. The regulations for the *grands prix de Rome* were also clearly defined. The Council of the School set the programme of the two preliminary trials as well as of the final competition, and the designs submitted in each of the three stages were adjudicated on by a jury composed of nine members for the section of painting, nine members for the section of sculpture, nine members for the section of architecture, five members for the section of plate engraving, and five members for the section of engraving on medals and gems. It was then first determined that the young men—painters, sculptors and architects—sent to Rome should be pensioned for four instead of five years, and their residence at the Academy of France at Rome was made obligatory for two years; the two remaining years might be spent according to their tastes or convenience in travel, provided they gave due notice of their intentions in that respect. The engravers were pensioned for three years only, and they were to stay at the Villa Médicis for two years at least. The Director of the Academy of France at Rome was to report every six months to the Minister on the work done there, and on the advance made by the students under his charge.

The State then, for the first time, established, in connection with the School, eleven Studios or *Ateliers*, and placed a professor over each, as *Chef d'atelier*. Three studios for painting, three for sculpture, and three for architecture, were organized. The academicians,

M. Cabanel, the late M. Pils and M. Gérome, had each charge of the painters' studios; the late MM. Jouffroy and Dumont, and M. Guillaume, all academicians, the sculptors' studios; the late M. Constant-Dufeux, academician, the late M. Paccard (entered at Rome in 1841), and M. Charles Laisné, the architects' studios. Besides these, one studio for plate-engraving was placed under the charge of M. Henriquel-Dupont, academician, and another for gem-engraving was established, with a technical professor at its head.*

As regards the School of Fine Arts no alteration in principle has since been made, though important modifications in points of detail were decreed in 1878; and on the 30th September last a decree of the Republic was signed, whereby the regulations of the School were revized, and its objects amplified. The clauses of institution are four, and I think interesting enough to be inserted here.

I. The National and Special School of the Fine arts is devoted to the instruction of painting, sculpture, architecture, plate engraving, and engraving on medals and gems.

II. The instruction comprizes:—

i. Oral courses of study bearing upon the different branches of art.

ii. The School proper, divided into three sections, viz.:—the section of painting, to which is attached plate engraving; the section of sculpture, to which is attached engraving on medals and gems; the section of architecture.

iii. The studios to the number of eleven, viz.: three for painting; three for sculpture, three for architecture; one for plate engraving; one for engraving on medals and gems.

iv. The collections. v. A library.

III. No one who is less than fifteen or more than thirty years of age can be a student of the School, or work in any of the studios.

IV. Foreigners may, by authority of the Director, study in the School and join in the competitions, on condition always that they fulfil the obligations which are imposed upon students of French origin.

The School is governed by a Council, consisting of 23 members presided over by the Minister, or by the Director of the Fine arts, or in their absence, by the Director of the School. Besides these three principal members and the Secretary of the School, fourteen members of the Council are chosen by the Minister, and five others are designated by the Assembly of Professors, but all are in the nomination of the Minister. The *ex-officio* Members of Council (April 1884) are:—

MM. Fallières, *Deputé*, Minister of Public Instruction and Fine Arts.
„ Kæmpfen, Director of the Fine Arts.
„ Paul Dubois, sculptor-academician, Director of the School.
„ Albert Lenoir, hon. academician, Secretary of the School.

The fourteen Members of Council† chosen by the Minister are:—

MM. Robert-Fleury, „ Meissonnier } painter-academicians. MM. Lenepveu, „ Baudry, } painter-academicians.

* I have purposely omitted any description of the numerous private *ateliers* in Paris, conducted sometimes by Academicians and almost invariably by professional men who have gained the honours of the Academy of France at Rome. For particulars of these, see page 113, in the remarks made by Mr. Spiers, during the discussion of this Paper.—W. H. W.

† Of all these only two are not Members of the *Institut de France.*—W. H. W.

MM. Guillaume, Inspector-general of instruction in drawing, „ Bonnassieux — sculptor-academicians.
„ Schœnewerk, sculptor.
„ Ballu, „ Garnier — architect-academicians.
MM. Chaplain, engraver-academician.
„ Vicomte H. Delaborde, Secretary of the Academy of Fine Arts.
„ Alexandre Dumas, academician.
„ Gréard, academician.
„ Crost, *chef du bureau* of Instruction.

The five Members of Council, designated by the Assembly of Professors, are—

MM. Gérome, painter, „ Cavelier, sculptor — Academicians.
MM. André, architect, „ Heuzey, archæologist — Academicians.

M. Brune, architect, Professor of Construction (see below).

The Professors teaching in the Studios, as *Chefs d'atelier*, are—

Academicians:
MM. Cabanel, „ Gérome, „ Hébert — Professors of Painting.
„ Cavelier, „ Thomas, „ Falguière — Professors of Sculpture.
„ André, „ Ginain — Professors of Architecture.

MM. Guadet, *grand prix*, 1864, Professor of Architecture.
„ Henriquel Dupont, academician, Professor of Plate Engraving.
„ Ponscarme, Professor of Engraving on Medals and Gems.
„ Maniglier, Professor of Sculpture in Stone and Marble.

The Professors commissioned to teach simultaneously the three arts are MM. Yvon, painter; Hiolle, sculptor; and Coquart, architect. The Professors for the courses of design and modelling in the School proper are four painters, namely, MM. Bonnat, Delaunay, Boulanger and Lenepveu, all academicians; and four sculptors, namely, MM. Guillaume, Chapu and Barrias, academicians, and M. Mercié. Their duty it is to direct in turns, during one month, the courses of study in the Evening School, and to set the programmes in painting and sculpture.

Special professors are also attached to the School, namely:—

One professor of Ornament-Drawing - - - -	MM. Ancelet, architect.
One professor of Perspective - - - - -	„ Chevillard.
One professor of General History - - - -	„ Lemonnier.
One professor of Mathematics - - - - -	„ Brisse.
One professor of Descriptive Geometry - - -	„ Pillet.
One professor of Stereotomy - - - - -	„ A. Durand-Claye.
One professor of Physics and Chemistry - - -	„ Riban.
One professor of Construction - - - - -	„ Brune, architect.
One professor of Building Legislation - - - -	„ Delacroix, barrister.
One professor of History of Architecture - - -	„ Lenoir, academician.
One professor of Decorative Composition - - -	„ Galland, painter.
One professor of Theory of Architecture, whose duties it is to set the programmes for the students' competitions in Architecture - - - - -	„ Edmond Guillaume, architect.
One professor of Literature - - - - -	„ Ruel.

One professor of History & Archæology - - - MM. Heuzey, academician.
One professor of History in Art and Æsthetics - - „ Taine, academician.
One professor of Anatomy - - - - - - Dr. Mathias Duval.

The section of Architecture is divided into two classes, in neither of which is any limit put upon the number of students. The Examination for admission to the second or lower class has hitherto consisted only of (1) a drawing of some ornament from the cast to be executed within the School in three sittings of six hours each; and (2) an architectural sketch or composition executed, according to a definite programme given to the candidate, in one sitting of twelve hours, during which he is locked up alone, or as it is termed "*en loge.*" A *loge* is a separate inclosure, within which a candidate works all day, beginning at 8 a.m., and, during the period of trial, he is not permitted to enter the *loges* of the other competitors or introduce anybody into his own. To these the new decree of 1883 has added the modelling of some ornament in low relief, to be executed from a cast, in the space of eight hours. This ordeal once happily passed, the candidate is permitted to continue his latter part of the examination for admission, which consists of oral and written exercises, viz.: (1.) arithmetical calculations done "*en loge;*" (2.) an examination in Arithmetic, Algebra and Geometry; (3.) An examination in Descriptive Geometry; (4.) Some test of Historical knowledge, to be evinced by oral examination and written composition. If the candidate's answers satisfy the examiners as to his fitness he is admitted into the second class of the School. He then works on the various competitions and other exercises belonging to this grade, which relate to both the science and art of architecture, to ornamental and figure drawing, and to the modelling of ornament. The programmes of these courses of study, which are all published, embrace Mathematics, Physics and Chemistry generally, Descriptive Geometry, Perspective, Stereotomy and Construction. The rewards given for these studies, consisting of medals and *mentions* of different value, determine admission from the second to the first class, in which a similar series of competitive and other exercises, though of a higher character, are required from the student. Medals and *mentions* of different value are given as rewards to the students who distinguish themselves in this class, as in the second class before described.

The prizes in architecture pertaining to the Ecole des Beaux-arts are awarded only to the students of the School, on the recommendation of a jury consisting of 30 architects, with the Director of the School as President. Other similar prizes are awarded in the sections of painting and sculpture, and in like manner the jury for painting consists of 30 painters, and the jury for sculpture of 30 sculptors. Of the thirty, the academicians, according to the section to which they belong, are permanent members, as well as the professors attached to the School, and other artists known to the Council as engaged in education—the number of permanent members never exceeding two-thirds of the total number, namely thirty.

A diploma is also granted by the School. The candidate has to give proofs of his competency, and is only permitted to do so after having obtained a certain number of medals, mentions, &c., in the various competitions of the School, or in the *Prix de Rome.* The examination for the diploma is divided into two parts: one graphic, the other oral. The former test consists of a set of plans, elevations and sections, of some building, including the details of construction, with the specification for a part of the building, and an estimate for that part. The latter test consists of an oral examination upon different parts of the design itself, and upon the constructive features, both from a theoretical and a practical point of view.

The candidate is examined on the qualities and defects of materials, their resistance, the means employed for their use on a building; on the History of Architecture; on the elements of Physics and Chemistry applied to Construction; and finally upon Building Legislation and Professional Practice.

An innovation of the recent decree is to be seen in the *Concours d'émulation* common to painters, sculptors and architects. This is neither more nor less than an attempt to teach simultaneously the three arts, for which purpose two competitions are open to those students who have obtained, in the sections of painting and sculpture, at least one *mention* in the study of the three arts; and in the section of architecture at least one *mention* in drawing from the figure, and one in drawing ornament from the round. The programme of these competitions is set by the Council of the School. The sketch (of some decorative composition) has to be made by the student *en loge* within twelve hours; the finished drawing within the delay of a month. The judges consist of the professors in this branch of simultaneous study, of ten painters, ten sculptors, and ten architects, chosen by ballot from the various juries acting, for the time being, at the School.

The competitions for the *grands prix de Rome* are open only to Frenchmen under thirty years of age, whether students of the School or not. In architecture, as in painting and sculpture, the competition is an annual one. The conditions of admission to the competition in architecture are very simple. In March of every year a preliminary trial takes place. The candidate has to make a sketch in twelve hours, and from the authors of these sketches the jury select twenty-five who have to undergo a second ordeal, which consists of another sketch to be made in twenty-four hours. From these last, ten candidates are chosen, and they enter *en loges* for seventy-two days. Three candidates are premiated. The first obtains a gold medal, which has always been, and I believe is still, regarded as the highest prize open to French students, and he leaves early in the following year for the Academy of France at Rome, where he is lodged and boarded for four years, at the cost of the nation. The competitors placed respectively second and third receive medals, and gain a just distinction thereby; they are also exempted, should they try again for the *grand prix*, from submitting preliminary sketches. The awards are made by the jury before mentioned, after the designs have been publicly exhibited; and at an annual public distribution of prizes, which takes place in October, the presentation, by the Academy of Fine Arts, of the *grands prix* of painting, sculpture and architecture, precede all others.

At Rome the student has a bedroom and a private studio allotted to him; he dines and sups at fixed hours at a common table; he has to conform to the rules of the Academy, and to submit while there to the orders of the Director. But so long as he fulfils his obligations in the matter of drawing, no restraint is put upon his actions. It is a part of his duty, after the second year, to visit the principal Cities of Italy, and he may extend his tour to Greece, a privilege which the student-architect rarely foregoes. During the first two years of his sojourn he has to make four studies of detail from such of the finest ancient buildings as he may choose; the third year he must also make four studies of detail, and add thereto a portion of an ancient edifice, showing its proportions and mode of construction. Tracings of these are preserved in the archives of the Academy, but the original drawings remain the property of the student. In the course of the fourth year he makes the geometrical drawings of an ancient building, either of Italy or Greece. These drawings are coloured and executed

from the building itself, representing it exactly as it appeared at the time. The student has also to make another set of drawings of the same building restored to its pristine condition, or as he supposes it to have originally been, adding an historical notice of it and its construction. He has also to make detail drawings, a quarter full-size, of the most interesting or characteristic portions of the building, which drawings become the property of the government.

It may well be imagined that the changes introduced and the apparent severance of Academy and School effected by Napoleon III were not received by the Academicians without a murmur, and if I had any sympathy for them in their imaginary loss, I should still rejoice that Marshall Vaillant, advised by the Count de Niewerkerke, acted as he did, even though his conception of the duties intrusted to him, as Minister of the Imperial Household and of the Fine Arts, had about it, possibly, more of a military than an artistic tinge. His action brought down upon him an eloquent protest written by the late M. Beulé, the permanent Secretary of the Academy, full of interesting historical facts. It moreover induced the latter to contribute to the *Revue des deux mondes* an account of the Academy of France at Rome, which gave the results of the French system of education, and afforded an eulogy as practical in its argument as it was splendid in phrase.

The year 1801, he declared, opened a new era for the School of Rome, and that is a phrase of Beulé's which has, I think, a little something of grandeur in it for our neighbours, and, to my mind, a terrible reproach to ourselves. The School had survived the Revolution, and had even gained by it, for while previously it had been protected by a few it at last obtained the support of the nation. He therefore, taking the long list of students of the School, named those who had known how to conquer and obtain, on unequal terms, either solid successes or public favour or glory. He began with a description of the painters, which was earnest, eloquent, convincing; he was enthusiastic over the sculptors. "Whence," he wrote, "does sculpture derive its strength and its teeming vitality, if it be not from sojourn at Rome, "from the contemplation of ancient marbles, from an intelligent study of the Renaissance, from "the works learnedly graduated of the Villa Médicis?" Let us draft, he continued in effect, a list of sculptors who have not been to Rome, and let us lay it side by side with that which I have presented: there will be found in it a few brilliant individual examples, but no such imposing array of talent as in mine. And I have not mentioned all the monumental sculptures, nor the innumerable bas-reliefs, nor the statues of great men, that our provincial cities jealously bid for, nor those admirable copies in marble, made in the museums of Rome and Florence, which adorn the School of the Fine Arts and other edifices of Paris. I do not know if I am blinded by national self love, but it seems to me that never, since the century of Jean Goujon and the century of Puget, has French sculpture held rank as high in Europe as at the present moment; and this place has been obtained for it by the School of Rome. Nor can I prevent a similar feeling when I regard the roll of our Roman architects, more especially those whose lives belong to the history of the present century. I will mention Huyot (*grand prix* of 1807), architect of the triumphal arch of the *Etoile*, the greatest, the most venerated of professors. Garnaud (1817) distinguished by the energy and the inexhaustible youth of his imagination. Blouet (1821) belonging to the school of draughtsmen and theorists, an eminent professor who has simplified and completed the great treatise of Rondelet, inscribed the name of France upon the fairest ruins of Greece, and produced a work on the *Morea* which has

surpassed the publications of the same kind undertaken by English architects. Lesueur (1819), archæologist, draughtsman, author, whose work has been crowned by the Academy of Inscriptions; above all things, architect of the Hôtel de Ville,* which he enlarged and finished after a preparatory study of many years. Gilbert (1822), the architect of the Hospital at Charenton, a composition both grand and monumental. Duban (1823), architect of the School of the Fine Arts, artist, endowed with an exquisite sentiment of soul, learned, delicate, seeking perfection and meeting it often. Henri Labrouste (1824), architect of the Library of Ste-Geneviève, and of the National Library, choice works, remarkable for their distinction, their *finesse*, their puissant originality. Duc (1825), architect of the Palace of Justice, in which everything reveals conscience, taste for the true, love for art; architect also of the Column of July, one of those works inspired from ancient models, but differing from any precedent.

From 1826 to 1848, continued Beulé, architecture was not less worthily represented by the French students of Rome. Vaudoyer (1826) erected at Marseilles a cathedral which is one of the memorable edifices of our century. Baltard (1833), author of the *Villa Médicis*, architect-director of the City of Paris, has applied iron to modern construction in a fashion both reasonable and elegant. Lefuel (1839) is the architect of the Louvre. Again, Ballu (1840), Paccard (1841), Tetaz (1843), and Desbuisson (1844), are of the number; as well as Normand (1846), architect of the house of Prince Napoleon, in the Avenue Montaigne, Paris. Then Garnier (1848), architect of the Opera House, winner of one of the truly-great competitions of our time; and here permit me to make a slight digression. Living in Paris at the time, I took part, as a subordinate, in the competition for the Opera House, but I was not aware of all the facts connected with it, until a day or so ago, when I read Beulé's article, from which I am now freely quoting. It appears that amongst the 173 architects who submitted designs, nine had been students of the Academy of France at Rome, and eight of these were included in the first batch of sixteen selected by the judges. Now all the designs were under motto, and out of that batch of sixteen the jury had to finally choose five. Of the five, four were the works of the students of Rome; and when these five gentlemen were invited in the second stage of the competition to submit complete designs, M. Garnier was unanimously chosen as the most worthy to construct the new Opera House. The open, unlimited, competition for that great work, which excited Parisian attention in 1861, sufficed to attract men of assured position and of the very highest talent. The drawings submitted, which were all publicly exhibited before the award was announced, were plain, unadorned, unpretentious sketches, made principally by the architects themselves, and sent in, in the majority of cases, without even an attempt at artistic finish. The public, who avoid even the gay and brilliant architectural room of our own Royal Academy, would not have wasted a glance upon such dreary pictures. Hence perhaps it was considerate and generous of the French administration, as well as lucky for our colleagues on the other side of the "silver streak," that the judges appointed to determine the selection of the architect of the new Opera House consisted exclusively of architects.

I have described a system of organization totally foreign to this country, and I have recorded some of its brilliant results. But I am convinced that many of my audience will say, or at least feel, that these great prizes of Rome are gained by only a few men. They are but

* Destroyed in 1871, and since rebuilt from the designs of MM. Ballu and Deperthes.—W. H. W.

a chimera to most of those who try for them. Yet this chimera, and I am using the late M. Beulé's words, keeps for ten years on the benches of the School five hundred artists, who work with energy, who refuse the temptation of facile gains and ephemeral successes, who, up to the last day of their thirtieth year, acquire skill, knowledge, consummate practice in their art; and who, when their last hope of the Prize of Rome is vanished, find themselves to be good painters, good sculptors, and good architects.

From 1720 until 1883, a period of 163 years, 164 French students of architecture have been sent to Rome, and have studied in the Academy of France there. The author of a notice* of Duban, Léon Vaudoyer and Henri Labrouste, enthusiastically referred to the devotion exhibited by them and other students of Rome during their early career. "I find," said the younger "Cockerell, a high ideal, involving a high ambition, pursued with a singleness of aim and an "untiring energy . . . . . . quite unsullied with any taint of greed. The early ambition of these "men, whether they are born to ease or to toil, is not to rush into practice, but to distinguish "themselves in the School, and to gain its honours and their crown—the *grand prix* . . . . . . "Their lives may indeed put us to the blush, and I cannot but feel, with humiliation, how great "is our need of the study of them." Nor, when the architect-student has fulfilled his task at Rome, does the State forsake him. On his return to Paris, he has a preferential right to employment on one or other of the public buildings in course of erection. He thereby becomes the subordinate of some academician, from which position, if he conduct himself satisfactorily, he rises perhaps to be assistant-architect, or even joint-architect. By the death or retirement of the architect of the building, he may be promoted at once to take the place vacated by his chief. The student of Rome has also, on his return, a preferential right to be appointed an assistant on the Council-general for Civil Buildings; and some of these students are often attached to the Inspectors-general, accompanying them in tours of inspection made periodically in Paris and throughout France. One other truth remains to be told. The student of Rome makes what our grandfathers called the grand tour. Our neighbours pay us the compliment of being greater travellers than they, because we visit Paris more regularly than they visit London. But all or most of the distinguished architects of France have resided for a time in Italy or Greece, and they have brought back in their portfolios, not mere pretty, effective sketches, but genuine architectural drawings, such as delighted the English masters of an earlier day.

Yet, patent as are the advantages of a system—the magnificent results of which can be judged by a study of the national edifices and public monuments of France—there are many people in that country, and a much greater number in this, who are satisfied that State-supported Academies and Schools are mere derelicts of Protection, and opposed in every sense to the glorious money-getting principles of Free Trade. But, to my mind, the difference between a body of architects trained under an academic system such as that which flourishes in Paris, and a body of architects left to pick up knowledge in a speculative scramble for employment, is not unlike the difference between an army of soldiers fit to take the field, and a scratch gathering of men with muskets.

If any plea were needed at the present time in favour of an English architect possessing, early in life, a scholarly acquaintance with the French tongue it might be found in the existence of that splendid literature which, during the last 250 years, has helped to

* See the TRANSACTIONS, 1875-76, page 209.

raise France to the summit of artistic eminence. It might also be found in the pleasure and profit to be derived from a true appreciation of the evident understanding, the polite consideration, the charm of manner, with which men of science and letters in France treat the ennobling subject of architecture. On the other hand, if anything could add to the depression which a reference to architecture occasions among similar sets of people in England, it might be found in the avowed opinions of many English scientists and authors successful in their line, and of many political representatives, successful in trade or commerce, whose blind confidence in the practical genius sufficient to make this country rich and powerful has blunted that perceptive faculty which should seek, I think, to crown the edifice by developing, to the highest possible degree, the literary, artistic and social instincts of the nation. The respect entertained by all classes of Frenchmen, irrespective of political creeds, for the Higher arts, has developed with the growth of their academies; and this has been aided by the close contact of academicians under the dome of the Mazarin Palace. Each academy in turn presides over the whole Institute, and last year the Academy of Inscriptions, being at the head, delegated a member who sat as President of the Institute, with a delegate from each of the other four academies as Vice-presidents, and the Secretary of the Academy of Inscriptions as the Secretary of the Institute. In like manner, each section presides in turn over the Academy of which it forms part, and last year the section of Musical Composition was at the head of the Academy of Fine arts. Thereby it fell to the lot of M. Gounod, the celebrated composer, to sit as President at the Annual Meeting, held on the 20th October last, when the *grands prix* in painting, sculpture and architecture were distributed, together with a large number of other prizes. "In Paris," I read in *The Times* of the 18th of January, "these great days under the "cupola of the Institute are the centre of interest to the whole of the classes which pretend "to any cultivation. There is no standard by which a man is measured in France higher "than the standard of his performances in literature and art. Wealth and birth are not allowed "by public opinion to have the *pas* of intelligence. Men of letters and great artists have a "position, as such, to which with us they have nothing comparable." If, as I believe, that be really the case, it is largely due to the beneficent influence of a system, prolonged for more than two centuries, by which School, Academy and State have worked together for the national good—a system by which the monuments of Greece and Rome have been brought under the dominion of Frenchmen, and thereby conferred on them the inheritance of intellectual arts that contributed to the glory of Athens, enabling the little republic to divide with Imperial Rome the homage of the modern world.*

WILLIAM H. WHITE.

* The Illustrations following this Paper consist of reproductions from drawings presented by the elder Vaudoyer in 1838. One [Illustn. xxiv] is a plan of the Palais de l'Institut as it existed in 1817; the other [Illustn. xxv] represents the central building (the work of D'Orbay) as Vaudoyer proposed to alter it in 1810, for the purposes of the Institut, then called Imperial. The portico, however, remains, at the present day, much as it was when originally erected. With regard to the interior, the general arrangement of the seats beneath the dome and in the transepts is almost identical with that shown in fig. 108. The numbers marked on that plan refer to items of description given in Vaudoyer's *Plan, Elévation et coupe du Palais de l'Institut Royal de France*. Paris, 1837. These references are:—1, Place du Palais de l'Institut; 2, Circular wings of the Palace; 3, Chief entrance court-yard; 4, Side court-yard; 5, Rue Mazarine; 7, Projected new portico, a model of which was executed at the marriage of Napoleon in 1810; 8 and 9, Fountains of 4 lions, executed in 1811; 10, Entrances from the *Place;* 11, Vestibules; 12, Entrance from the Court-yard; 13, Principal staircase to the

[Remarks made by R. Phené Spiers, F.S.A., *Fellow,* Master of the Architectural Class at the Royal Academy.]

Some account, slightly more in detail than is given in the Paper, of the history of the French School of Fine Arts, including the peculiar system organized there for the teaching of architecture, is, I think, desirable. Mr. White has perhaps not drawn sufficient attention to the three *ateliers,* established in 1863, in connection with the School. He has mentioned that in that year a great change took place in its organization, but the great step which was intended to be made then was effected by a sort of *coup d'état,* and was done at the instance of M. Viollet-le-Duc, who had considerable influence with the Emperor. Finding that the study of mediæval art was more or less entirely ignored by the Professors of the School, he endeavoured to provide for, as he said, greater freedom of thought, by insisting that all the students should be taught in future by those whom he suggested as teachers—a very singular way of effecting his purpose. Hence the establishment of the three *ateliers* in the School, but the proposition that they should be the only *ateliers* for students was quite impossible to carry out. The students absolutely refused to listen to M. Viollet-le-Duc. Day after day he attempted to lecture, but it was quite impossible to hear a word, and in the end he was defeated, and obliged to give up. The result was, that, as a sort of compromise, three State *ateliers* were established, but others were allowed to exist outside. Now, what are *ateliers?* They are studios in which the students of the Ecole des Beaux Arts prepare and work out their designs under the direction of a *patron* (as he is termed). The *patron* of the

Library; 14, Stairs to the Galleries; 15, Reception Hall; 16, Orchestra; 17, Reception Hall, called Minerva, with the statue (43) of Napoleon the Great, re-instated in 1835; 18, Small Halls; 19, Great Hall under the dome, used for public meetings of the Institut; 20, Places for the President and Secretaries; 21, The reader's or speaker's desk; 22, Places for the Academicians; 23, Places for the Ministers and Ambassadors; 24, 25, 26, Amphitheatres. The following statues in marble are also marked on the plan [Illustn. xxv, fig. 108]:—28, Six statues of sovereigns; 29, Bossuet; 30, Fénélon; 31, Descartes; 32, Sully; 33, D'Alembert; 34, Montaigne; 35, Molé (President); 36, Montesquieu; 37, Cassini; 39, Rollin; 40, Montausier; 43, Napoleon the Great; 44, Racine; 45, Corneille; 46, Pascal; 47, Molière; 48, Lafontaine; 49, Poussin.

⁂ A private letter, addressed to the author of the Paper by Mr. Arthur L. Tuckerman, who, at the present moment, is a Student of the Ecole des Beaux-Arts, and who has resided for some years in Paris, gives a fair idea of what a young American gentleman thinks of the School, and of the work he has to do there. An extract is here printed:—

Dear Mr. White,— *Paris, March 20th,* 1884.

Perhaps a few details of the every-day life of the students of the Ecole des Beaux-Arts may be of interest. The first formality of entrance for a new member is to present himself to the professor at the head of the *atelier* or studio to which he desires to belong. The professor looks over the work he has been doing previously to his coming to the school, gives him advice on the subject of his preliminary studies, and appoints an hour when he will introduce him to his new companions. Before entering, if a Frenchman, he brings his certificate of birth to the secretary, who puts his name on the books and gives him a card of entrance to the different *cours.* With foreigners, a letter from their minister or consul, giving particulars of birth and nationality, is all that is required. There are, as you know, several studios both in and out of the School, but the larger ones are, on some account, the most popular owing to the amount of instruction to be obtained in them, from the fact of having a greater number of workers and a consequent greater variety of ideas collected together. In fact, though an *atelier* is directed by a professor attached to it, the success of the system is due, not alone to his teachings, but to the facilities afforded for seeing and profiting by the work of the best draughtsmen. The new man, once fairly launched, begins to prepare himself to pass the examinations, which entitle him to be called an "*élève*" of the School. These examinations, of which you have already a list, are perhaps elementary, but they demand a perfect knowledge of the subject, and it can be safely said that none get through

atelier to which I belonged was M. Questel, who succeeded to the *atelier* of Blouet and Gilbert. When the latter died, Blouet wished to give up the *atelier*, so the students belonging to it met together and elected M. Questel as their *patron*. I should think that, at that time (1860), there must have been at least twenty *ateliers* in Paris. These *ateliers* have no official connection with the Ecole des Beaux-Arts, but the students belonging to them are allowed to place at the bottom of their drawings, after their own names, the name of the *patron* or *patrons* under whom they are studying.

The usual time to enter an *atelier* or studio is from four to six months before going in for the examination of the school. An *atelier* consists of one or more rooms, from 20 to 30 feet square, lit by top light; generally, therefore, on the upper floor of a house, or in the back part of the premises on the ground floor. The new-comer (*nouveau*) pays an entrance-fee of 20 francs (15 francs to the library, each *atelier* possessing a small collection of illustrated books for reference), and is expected to bring a double-elephant and imperial drawing board with T-squares to match. The *atelier* is furnished with drawing tables and stools; the rent and cleaning are paid by the *patron*, and the firing, repairs of stools and tables, water-jars, palettes, strainers for drawings, &c., are paid for by a monthly contribution of from 3 to 4 francs from each student regularly working there. A *nouveau* pays 20 francs a month to the *patron* before entering the School, and 40 francs afterwards for every complete design worked out and sent in (*projet rendu*), as it is calculated to take two months to study and work out. Unless of a bright and forgiving disposition a *nouveau* has rather hard times at first, and becomes a sort of fag. His duties are: to clean out the palettes, if that has not been

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without proper preparation. This is on some grounds well devized, as it prevents many outsiders from obtaining the right of calling themselves members who have never worked in the School. In this I speak chiefly with regard to the architectural department, which in this case is the one of most interest. The course of work is invariably the same: at stated intervals the programme of a building is given out, and a certain time allotted for the preparation of the plans, elevations, details and sectional drawings, which are afterwards exhibited in a hall reserved for this purpose. All drawings of merit receive "mentions;" these count as so many "*valeurs*," which permit the student to pass from the second to the first or upper class. These drawings are prepared by the men in the studio, all working together and having unlimited opportunities of criticising each other's work; discussing difficult points, and seeing in what way the strongest men go ahead. There is no feeling of jealousy at any man's success, but all work together with a genuine desire for improvement. The point on which French architects stand pre-eminent is planning, and in the School special attention is given to planning. Each plan is prepared with due regard to the requirements of the particular building it is intended for, composed with the greatest deference to proportion and symmetry, and the elevations follow as natural consequents. The principle of all the design is that every building shall have its own character, as a natural development of the use it is put to. Questions of cost and size are never particularly binding, as the object of the school instruction is to teach men to compose and design logically. In addition to drawing, there are lectures given on mathematics, construction, history and other subjects relating to architecture; the attendance on these is in all cases gratuitous. There are examinations held on these branches, for which it is necessary to qualify to become a member of the first class. It is after entering this that the student turns his endeavours to obtain the "diploma" of the School and the *Grand Prix de Rome*. In all the course of design, the object before him is to compose everything in the best way—with unlimited means—anything like ingenuity or economy of work never being considered a feature of merit. It is, perhaps, justifiable to say that though the student may have to come down from his high horse, when in actual practice, his knowledge of what the work ought to be will enable an architect to do better things than one who has remained below, and never developed his view of what can be done. The daily life is an agreeable one; the French are gay and good-tempered over their work, and all who have been at the School leave it with pleasant souvenirs.

ARTHUR L. TUCKERMAN.

done by the ordinary servants of the establishment; to fetch the luncheons of those students who break their fast between 10 or 11 a.m. and dinner at 7 p.m. by *petits pains* or light pastry of some kind; and last but not least, to mount with mouth-glue the sheets of paper required by the students of the senior class, and generally a nice hash he makes of it at first. To know exactly how much to wet the back of the sheet of paper, how near with a wet sponge to approach the border, how with a drier sponge to wipe round the border—all the time getting prepared in your mouth the (sometimes very dirty) piece of mouth-glue (*colle-à-bouche*)—while the operation of sticking down has to be effected, is by no means an easy task at first. In "drawing-room" *ateliers* they try to do this with hot water, but the mouth gives the right warmth and the right amount of moisture. How much or how little to stretch the paper across, sticking down in the centre of each side at first; how much pressure should be applied in rubbing the mouth-glue under the edge of paper; with what delicacy to rub down with handle of knife or latch-key the paper after the application of the mouth-glue—all these are refinements only to be appreciated by one who has gone through the training of a *nouveau.* The new student comes to the *atelier* as a general rule with a fair knowledge of drawing, specially from the round, which he has acquired in one of the Schools of Design in Paris or the provinces; his first work in the *atelier,* after straining his own paper, is to commence careful drawings of the "orders" which are subsequently shaded in flat or graduated washes of Indian ink (which the French call by its right name, *encre de chine*). For inking-in or shading it is rubbed up specially for each operation, and after two hours is thrown away, and fresh rubbed up; to keep it in a bottle always ready for use would be repulsive to a French student. As a variation to the above work the *nouveau* takes up the last, or some previous, subject set by the *patron,* and obtains, whilst working out the design, the advice of the senior students, in return for which he is expected, two or three days before the time for sending in the monthly designs to the School, to work on their drawings, blacking-in a plan, repeating some features in the section, &c. This assistance on other students' drawings is not confined to the new students—the first-class students and the second-class students send in their designs in alternate months, and thus are able to work for one another. As a rule the finished drawings are begun rather late, and towards the end of the month most *ateliers* are "*en charrette,*" a term for which I have never been able to obtain a satisfactory explanation: hard pressed would be the nearest meaning. The whole strength of the *atelier* comes down on these occasions, specially for the last two or three nights, up to 12 o'clock, to pull the men through; those who work for other men are called *nègres,* and a nice time they lead their masters, who, temporarily, are called *patrons.* Some pass the night working, and this is often done; some stop till 2 or 3 a.m. only. About an hour before the sending in, all hands are required for mounting the drawings on strainers, which is done by mouth-glue as before, and strips of grey or blue paper are pasted round the edges. At 10 o'clock (now mid-day I believe) may be seen, in the streets in the vicinity of the Ecole des Beaux-Arts, a procession of students with strained drawings, some with pallid dirty faces and rough hair, evidencing their having worked through the night, others fresh and bright, the relief party.

So much for the *atelier* work, and now for the Ecole des Beaux-Arts—the University as it were in contrast with the Colleges, which in this case are the *ateliers.* Every student

of the School is allowed to study where he likes, only there are certain restrictions—that is to say, that in making out a complete design the student is obliged to attend *en loge*, where he is separated from his brother students by a partition, and in the course of twelve hours he has to make a design for a subject, the programme of which is given on entering his *loge*. He is required to make a plan, elevation and section which is left in the School, and from which he takes a tracing to work out in the *atelier* of his *patron*, from whom he obtains advice upon the various modifications. He is not allowed to depart from that design in any material way, or he is excluded from the competition when he sends his design in.

It might seem impossible, with a large number of students (there were 150 in the *atelier* when I was there), for a busy man like M. Questel to give that time to the students which would be necessary, but such is not required in a French *atelier*. The very fact that there are certain men competing for the *Grand Prix de Rome*, and that these men may not possibly get the prize until they have been students for ten or twelve years, keeps in each *atelier* students of different standards of power. The Professor naturally gives his time to those who are senior, and who are most likely to profit by it; the senior students give their advice to the juniors, and the juniors to the new students. There is, therefore, an accumulating amount of advice : not only does the young student profit more by the advice of those who are a little older than himself and able to tell him more abruptly what their comments are, but he has also the advantage of seeing a number of other designs of the same programme worked out in the same *atelier*. The accumulation of knowledge from any one *atelier* must naturally be very great. Each man in the *atelier* is of course to a certain extent in friendly rivalry with his brother students in the same *atelier*, but each *atelier* is much more in rivalry with the others, and therefore the students in each *atelier* work together to raise the standard of design, and help their own men on in every way, and what is most hoped is that the students of one's own professor shall obtain the largest number of awards. It is difficult to conceive the extraordinary effect that this has upon the French students, and no single mastership of any school could possibly arrive at the result in such a short time. This *esprit de corps* amongst the students of an *atelier* is very remarkable. They all *tutoyer* one another, *i.e.*, they use the second person singular; which is a sign of great intimacy. Many of the acquaintanceships last through life, and for years after the period of studentship an architect who is competing for some public work can count upon the assistance of his old comrades for an evening or two at the end. And in the *atelier* itself, the eve of sending in an important *concours* of the first class students will bring down old students, who set to work at once on the drawings of the man most behind-hand.*

The reason of three ordeals for the *Grand Prix* is partly this: those who have already competed in previous years, as well as the students of the first class, are exempted from the first ordeal. The second ordeal is that out of which the ten final competitors are chosen. The first ordeal takes twelve hours; the second twenty-four hours (they come at 8 o'clock in the morning and are there until 8 o'clock the next morning, but they can go out of course when they have finished their design). In the third ordeal for the *Grand Prix* the ten men are put

* The competition drawings just described are called *projets rendus*, and the sketches made on the first day *esquisses pour projet rendu;* in the alternate month *esquisse-esquisses* are made—smaller subjects conceived and finished in colour in the one day.—R. P. S.

in separate rooms for three whole days; they are supplied with provisions, and sleep there. In those three days each has to work out a sketch-design, which is generally for some large or important building or assemblage of buildings. This sketch-design is covered with a sheet of tracing paper, and the stamp of the Ecole is put upon it, so that no alteration can be made. The competitors are then given back their sketch-designs to work out the final design from. They are allowed to go home and take tracings of their designs with them to study. The first thing they do is to go to their own *patron* and get his advice as to what they shall do, but the whole of the drawing is necessarily entirely made by themselves, because it is done *en loge.*

I suppose that one of the great difficulties we all have in our offices here, is the absolute ignorance of many young men in drawing. They are probably received with a favourable report from school that they are fond of drawing, which is generally illusory. In France this is not the case. There, almost every student who comes up to the Ecole des Beaux-Arts has certainly at some time been in one of the Petites Ecoles de Dessin. These are schools for drawing which are formed at the expense of the Government, and as a rule every French student entering an *atelier* has a fair knowledge of freehand drawing. In some cases these Petites Ecoles de Dessin in the provinces go so far as to award a travelling studentship—that is to say, they will send a student to Paris to the Ecole des Beaux-Arts, in other words, give him a scholarship for one or two years, as the case may be. In France traditional design has always been kept up, whereas here it has often been stopped at the death of any great master. Mr. White quoted from a notice of M. Duban, by our poor friend Frederick Cockerell, and perhaps he was the only one who thoroughly understood the peculiar feeling and sentiment of French architects. Now, when Joseph Louis Duc came here to receive the gold medal, he was a guest in the house of Mr. Cockerell, and I remember M. Duc saying:— "By the way, a most singular thing happened to me about two or three days ago, a "gentleman came to me and asked me to build a house for him. I have never had such "an offer in my life before. I have always been employed on the Palais de Justice, and I "was a little diffident to know what to do." This house was apparently the first job outside his official work that M. Duc had to carry out, for he had been some thirty years confining his attention to one great building.

We find in France men who study, I will say, up to the age of twenty-eight or thirty, for the *Grand Prix,* and then go to Rome for four years (it used to be five), and come back at the age of thirty-two to thirty-four, without, I may say, any practical knowledge or any knowledge of construction beyond its theory, and certainly without any economic knowledge of material. How do they get on, and what do they do when they first start? The Government recognizes the fact that a man who has spent so much of his time in the study of fine art, and has contributed so much by measuring ancient buildings, and sending his drawings of them home for the study of younger students, has a claim on the State; and he is invariably appointed to some public building where he obtains his practical knowledge. In almost every case the *pensionnaire* coming from Rome has been appointed to some public building, with sometimes only a nominal sum allowed him. A similar appointment as *Inspecteur* of a public building enables many men of less eminence to start in practice. If an architect can get an appointment with 1500 or 2000 francs a year, the office hours being 12 to 4, it leaves him

all the morning to himself, and a student of the first class, especially if he has taken his diploma, can be sure of obtaining one of these appointments on the numerous public buildings in France. It is in that way that they acquire practical knowledge, and as soon as they have acquired it, the post of *Inspecteur* is given up, and they go out on their own account.

There is one great difference between the French system and our own, and it not only applies to architecture but to every other art, and that is, the entire absence in England of any study of composition, and of the complete way in which it is taught in France. I have just incidentally mentioned that sketch-designs have to be made in the School, from which a tracing is taken, and study after study made under the guidance of *patron* and fellow-students. What is the difference between the English and the French student in this respect? The English student makes no sketch-design; he begins at once with his 2-foot rule to put the exact size of every feature in the building, without going one single step further in the study of design. He does not consider proportion or anything. He gets the height of the floors, &c., and puts everything at once to scale; and it is impossible to get him to understand that, if he wants to arrive at any proper standard of excellence, he should make five or six different studies—sometimes ten or twelve studies of the same building—before he can digest all its details. Some of our greatest architects have never adopted that system, and it is said that Mr. Street never used a piece of india-rubber, but he had acquired to a certain extent the power of making up his mind first what he was going to do; and according to this power so are the results of his work. In all foreign work composition is studied to an immense extent. It is not only the case in architecture, but equally so in painting. There is no study of composition in England, and the painters have to pick up as they can any knowledge they have of it. Nor is the study of composition in language, even, taught here as it is in France. Any who have seen the letters of boys at school in France will be struck with the immense difference between them and those written by boys in English schools; the letters of the latter are usually confined to asking for more pocket-money. The letters written by French school-boys are admirable specimens of prose writing, carefully considered and worked out as the results of their teaching.

R. PHENÉ SPIERS.

[Remarks by Arthur Cates, *Member of Council.*]

Special attention should be paid to the *Diplôme d'Architecte,* which has been introduced so recently into the Ecole des Beaux-Arts, as being a question of great interest, deserving the closest attention from this Institute. This question of a diploma had been agitated in France for more than thirty years. An architect, the late M. Adolphe Lance, published in Paris, in the *Encyclopédie d'Architecture,* several articles on the subject, in which he detailed the proceedings of the Société Centrale des Architectes, of Paris; in 1855 he published those articles in a collected form.* In 1855, at the inaugural meeting of the Architectural Association, Mr. Tite, who was then Vice-President of this Institute, attended, and the address given by Mr. Alfred Bailey touched upon that subject. In his opening address of Nov. 5th,

* *Du Diplôme d'Architecte,* 8o, Paris, 1855. A copy of this *brochure,* presented by the author, the late M. Adolphe Lance, architect, is in the Library.

1855, he (Mr. Tite) expressed surprise at what he had heard at that meeting of the Association. He said that it appeared that the members felt the necessity of something like a diploma, or some other recognition of their attainments, and that they were willing to submit themselves to an examination in order to obtain acknowledgment of their professional merits and attainments. At a later period of that session, Mr. John W. Papworth* brought before the Institute a translation of the tract of M. Lance, which led to considerable discussion. In that tract M. Lance says that Roland Le Virloys in 1770 writes: "As soon as a man knows a little of drawing he "sets himself up as an architect." The same evil now complained of in England existed in France more than a century ago. He also cites a curious statute of the Spanish government as regards architects (1801), which sets out the curriculum of examination for the diploma in architecture, and it provides for this curious distinction: that no architect who has not passed an examination shall be employed by the State, but that any private person may employ anyone he pleases as an architect, but if he has not passed an examination he shall not be responsible to his client. Now the responsibility of an architect is a very serious thing, it is a question here treated very much as one which it would be as well to gloss over; it is, however, one which in France and elsewhere assumes an importance which would astonish many of our practitioners in England, and it would be an exceedingly happy state of things for this country if some such principle were established in England, that no other than an architect who holds a diploma should be employed by the Government. The feeling of that period (1855) seems to have been that it was desirable to make a clear distinction between the *architecte*, the *vérificateur*, and the *entrepreneur;* a distinction, which, unfortunately in England at this time, as in France then, is one which it is exceedingly difficult to define. The public did not appreciate the difference between these three different employments, and the endeavour was to establish some principle which should enable the architect to obtain due credit for his study and his knowledge, and to receive a certain distinction, which would be a guarantee to the public that, at all events, the minimum knowledge necessary to any individual practising in the profession had been attained. At that time, before the re-organization of the Ecole des Beaux-Arts, there was much discussion as to the influence which any examination might have upon the progress and development of architecture; there was a fear that the influence of any academy upon the teaching of that art, and upon its practice, by the granting of a diploma might tend to limit it to one particular class, or one particular school, of design, and that the architecture of the country would become the architecture dictated by the professors of the academy. Particularly on that ground the efforts that were made at that time to establish something like a diploma failed. There was also a similar feeling at that time in England. M. Lance, in his pamphlet (page 45), repels most decidedly every proposition which would attempt to establish a distinction between one who was improperly called the architect and who was purely artistic, and the architect who was a constructor: "In the true "and technical acceptation of the word there can only be one sort of architect: he who unites "at the same time, in a greater or less degree, theoretical with practical knowledge. The "simple draughtsmen, equally with those who only understand construction, cannot be "architects." It appears, from what Mr. White has said, that the Ecole des Beaux-Arts has recognized the importance of this principle. The programme he mentioned, as I

* See the TRANSACTIONS, 1855-56, page 23.

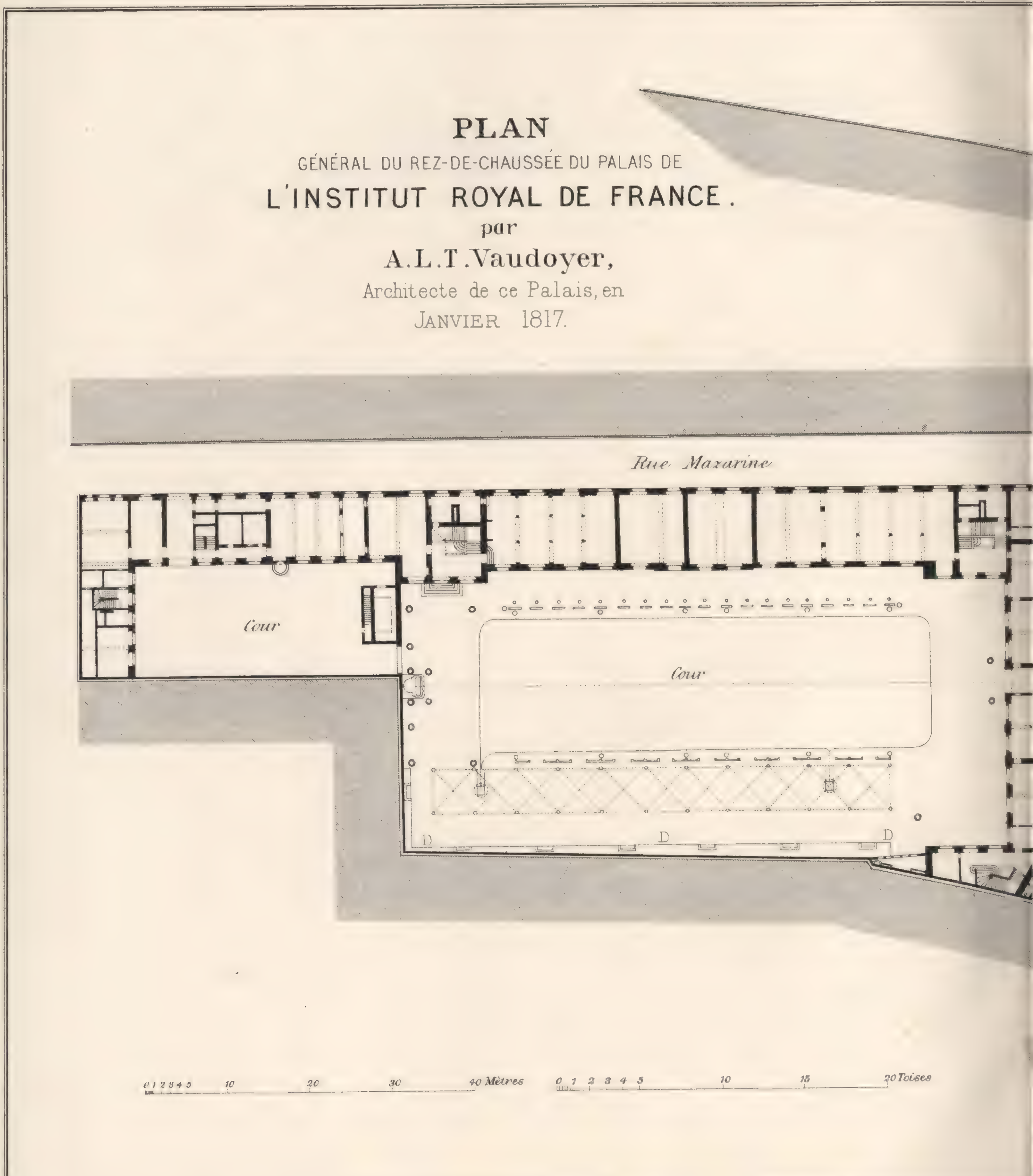
understand it, comprizes not merely the architectural composition of the design, &c., but that technical knowledge which it is absolutely necessary for every architect to possess; that mathematical knowledge which, in a greater or lesser degree, must be the foundation of his art; that knowledge of descriptive geometry which unhappily in this country is heedlessly ignored almost entirely, not only amongst the architects, but also amongst the working-men, even the masons and the carpenters. It also comprizes questions of chemistry and physics bearing upon the practice of architecture, which, it is to be regretted, this Institute has been compelled to omit from the programme of its examination. Therefore the step which the Ecole has taken with regard to these examinations for the *Diplôme d'Architecte* is one which concerns this Institute very much, and one to which the greatest attention should be given, because, within the last three or four years, after an interval of more than twenty-five years, the Institute has listened to the Prayer of the Memorial* of the Architectural Association, of 1855, and has established an obligatory examination to qualify for the Associateship of this Institute, which has been most wrongly spoken of, with scorn and contempt, as being only a surveyor's examination. There is not one single matter in the whole curriculum with which architects should not be thoroughly acquainted in its fullest details, and no man can profess or call himself an architect honestly, or practise his profession, unless he is intimately acquainted with all the subjects contained in that curriculum. It is only to be regretted that it is not far more extended, and that it does not follow the lines indicated by Mr. White in his description of the Examination for the diploma of the Ecole des Beaux-Arts.

It has been my lot in various continental cities to come in contact with architects of high position, and frequently to engage in conversation with them, when they have suddenly left me, saying, "I must go to my Lecture at the School or at the University." There you have men engaged in practice on buildings, only one of the like of which most of us would be proud to have in a lifetime; there they are engaged as professors of architecture, and having their classes. Something similar is now taking place in London. In a reorganization of the schools at the Academy, under the late Mr. Street, the Royal Academicians undertook to attend the Architectural Class, which is under the direction of the Master, Mr. Spiers; on certain evenings a skilled architect and a Royal Academician, a man of eminence and power, like Mr. Street, who has personal contact with the students, is enabled, in a few words and by a few touches of the pencil, to give to the student a marvellous inspiration in design which that young man can obtain in no other manner. I think that the combination of the education which is now opened to the student in architecture at the Royal Academy, and the curriculum which he must pass through for an examination as an Associate of this Institute, should lay the foundation of an education which should be exceedingly advantageous. In reference to that point I may very well allude to a striking remark made to me at, I think, the last Obligatory Examination in Architecture. A gentleman who was a candidate, and had passed a very good oral examination, happened to be a little at sea with respect to certain books which he had not had an opportunity of seeing. On my pointing out his shortcomings, he said, "I have to express my obligation for this examination, because from

* See the TRANSACTIONS, 1855-56. This Memorial is printed at pages 38, 39, Report of Proceedings, 3rd December, 1855.

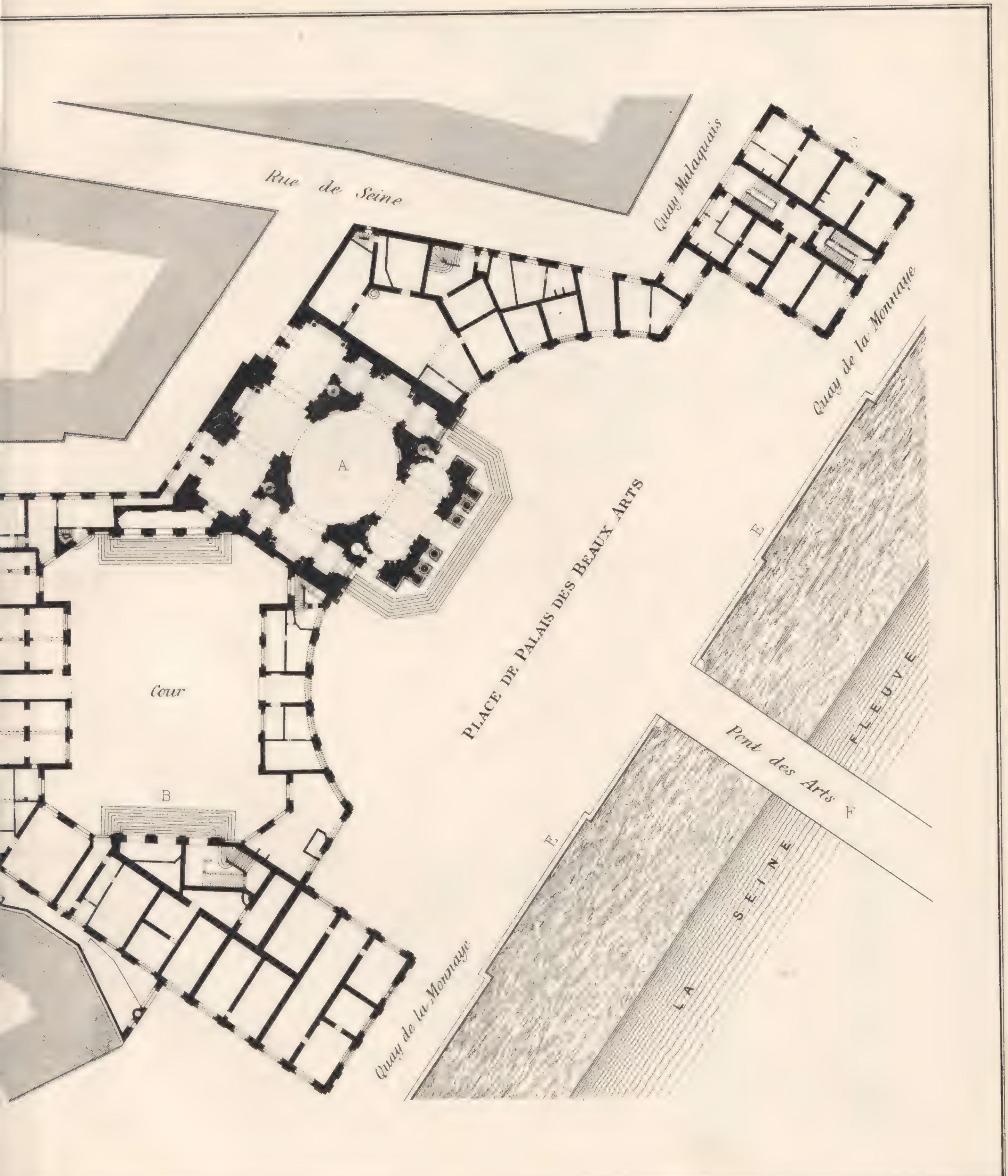
"this day my education as an architect commences"; and unless every candidate who comes up for the examination is imbued with the same feeling, the examination will be of little use. In my opinion the publication of a Paper such as that read by Mr. White will tend to advance the interests of the profession in this country, and to strengthen the Institute as the representative body of British architects, admission to which can only be obtained by having passed some examination, which shall be the test that every Member does at the least possess the minimum of knowledge that every architect should have acquired.

ARTHUR CATES.



A. *Dome of the Institut de France,*
B. *Entrance to the Bibliothèque Mazarine,*
C. *This Pavilion has been considerably altered,*

FIG. 106. REDUCTION OF A PLAN PRESENTED IN
BY THE ELDER VAUDOYE



C. F. Kell. Lith 8, Castle St. Holborn. London. E.C.

838 TO THE INSTITUTE OF BRITISH ARCHITECTS
R, HON. CORR. MEMBER.

D. *A block of buildings has since been erected here,*
E. *This Quay has since been enlarged and its name changed,*
F. *A new bridge has been built,*

ORIGINALLY THE CHURCH OF THE COLLÈGE DES QUATRE NATIONS
LEVAU AND DORBAY, ARCHITECTS.

FIG. 107. ELEVATION OF THE DOME OF THE INSTITUT DE FRANCE, SHOWING THE PORTICO AS PROPOSED, BUT NEVER EXECUTED, BY VAUDOYER IN 1810.

EXTRACTED FROM THE "PLAN, ELÉVATION ET COUPE DU PALAIS DE L' INSTITUT DE FRANCE",
A. L. T. VAUDOYER, ARCHT

SEE, FOR THE REFERENCES TO THE NUMBERS ON THIS PLAN, THE FOOTNOTE TO PAGE III

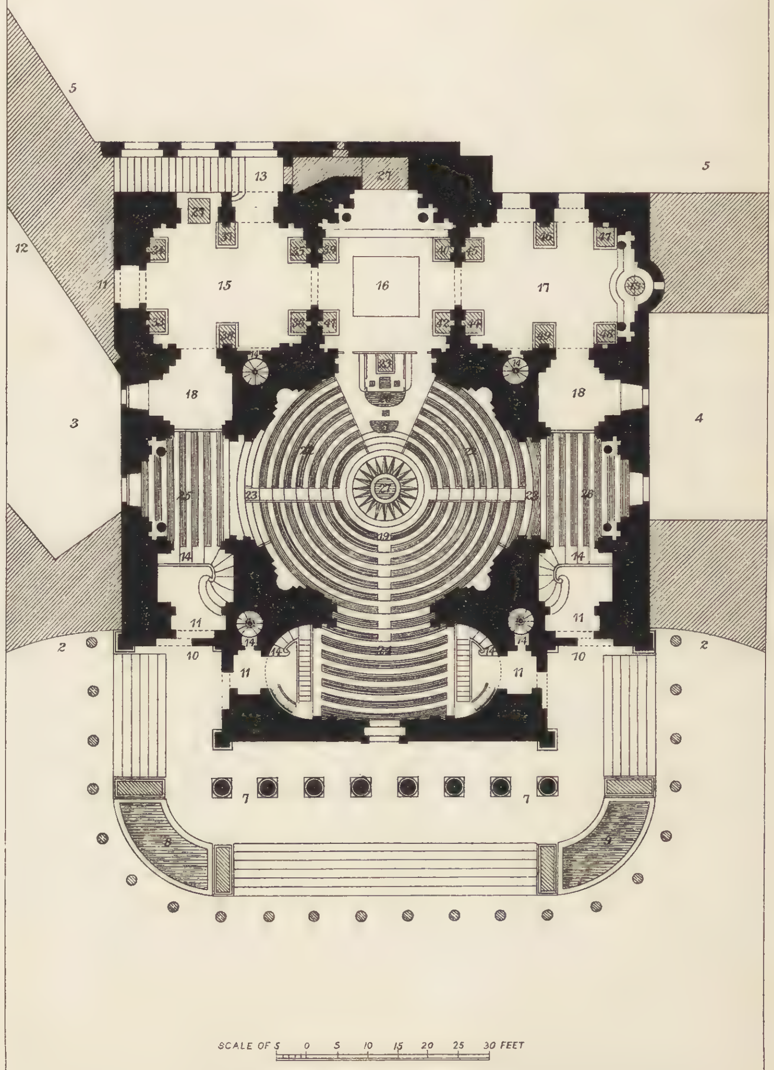
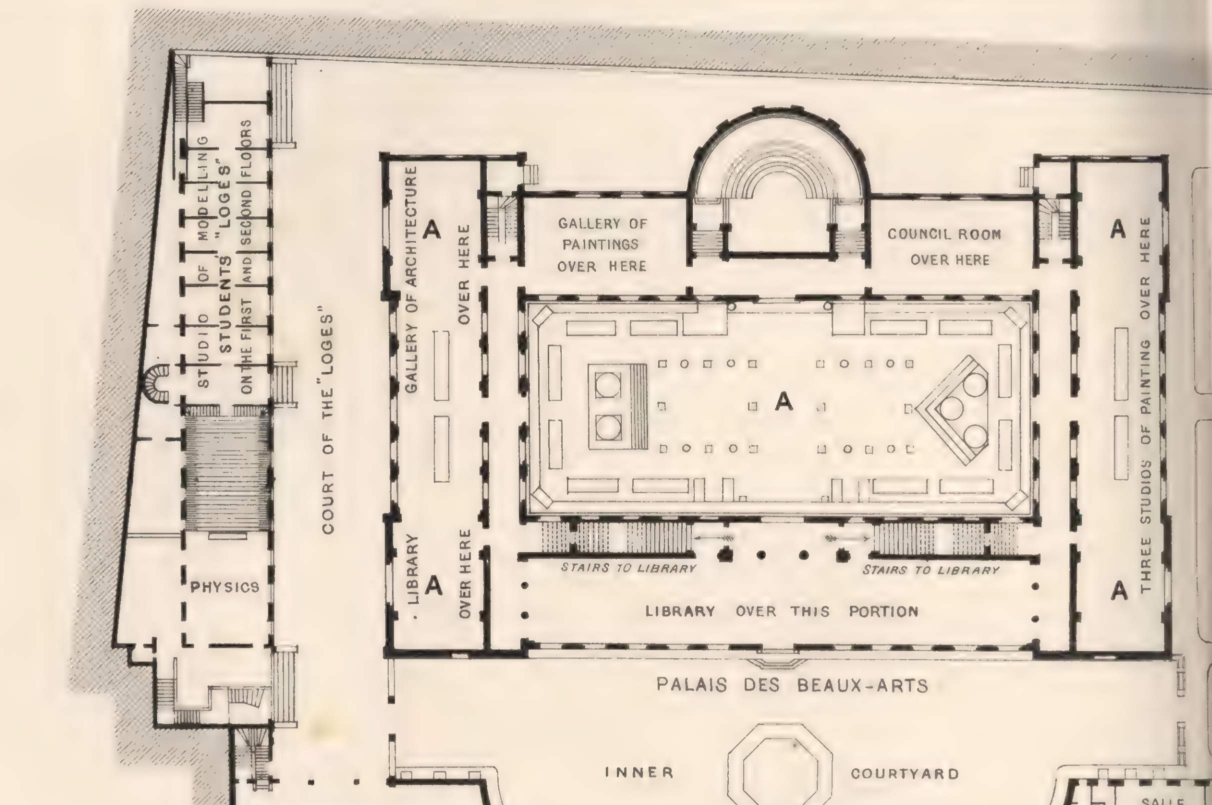


FIG. 108. PLAN OF THE SAME, SHOWING THE ARRANGEMENT OF SEATS, AS DESIGNED BY VAUDOYER, AND STILL EXISTING.

C.F. Kell, Litho. Castle St Holborn, London, E.C.



RUE BONAPARTE FORMERLY

ENLARGED FROM A SKETCH PRESENTED BY M. MÜNTZ, CURATOR OF THE ÉCOLE DE BEAUX-ARTS.

FIGS 109 & 110.

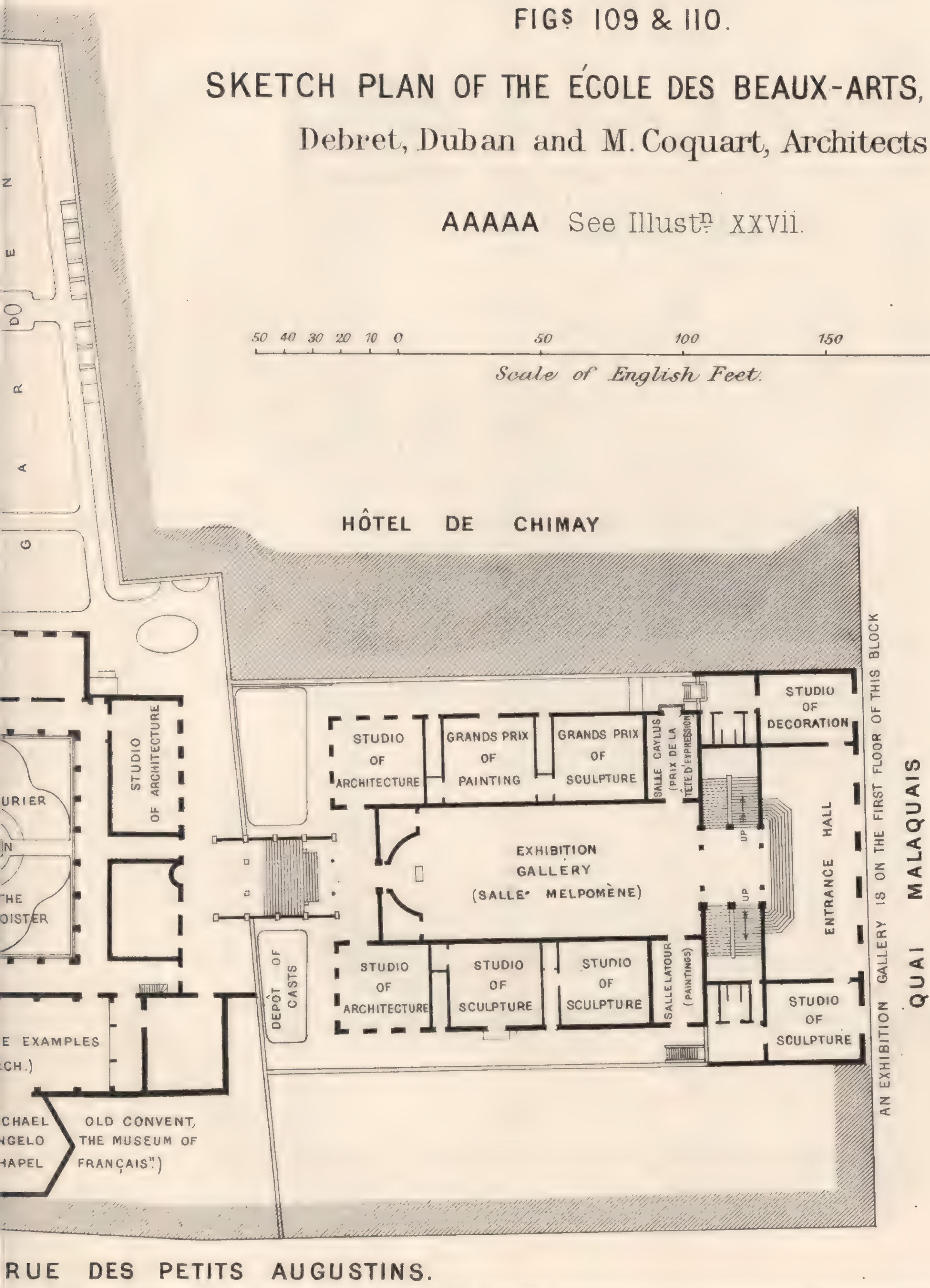
SKETCH PLAN OF THE ÉCOLE DES BEAUX-ARTS, PARIS.

Debret, Duban and M. Coquart, Architects.

AAAAA See Illustn. XXVII.

50 40 30 20 10 0 50 100 150 200

Scale of English Feet.



THE RIVER SEINE RUNS ALMOST PARALLEL HERE WITH THE LINE OF BUILDINGS.

C. F. Kell, Lith. 8, Castle St. Holborn, London, E.C.

VI. EDUCATION AND POSITION OF ARCHITECTS IN FRANCE SINCE THE YEAR 1671. (XXVII).

a. IRON COLUMNS SUPPORTING GLASS ROOF OF GREAT HALL
G. MONUMENT TO DUBAN, ARCHT

D. COLUMNS OF THE TEMPLE OF JUPITER STATOR
E. ANGLE OF THE PARTHENON

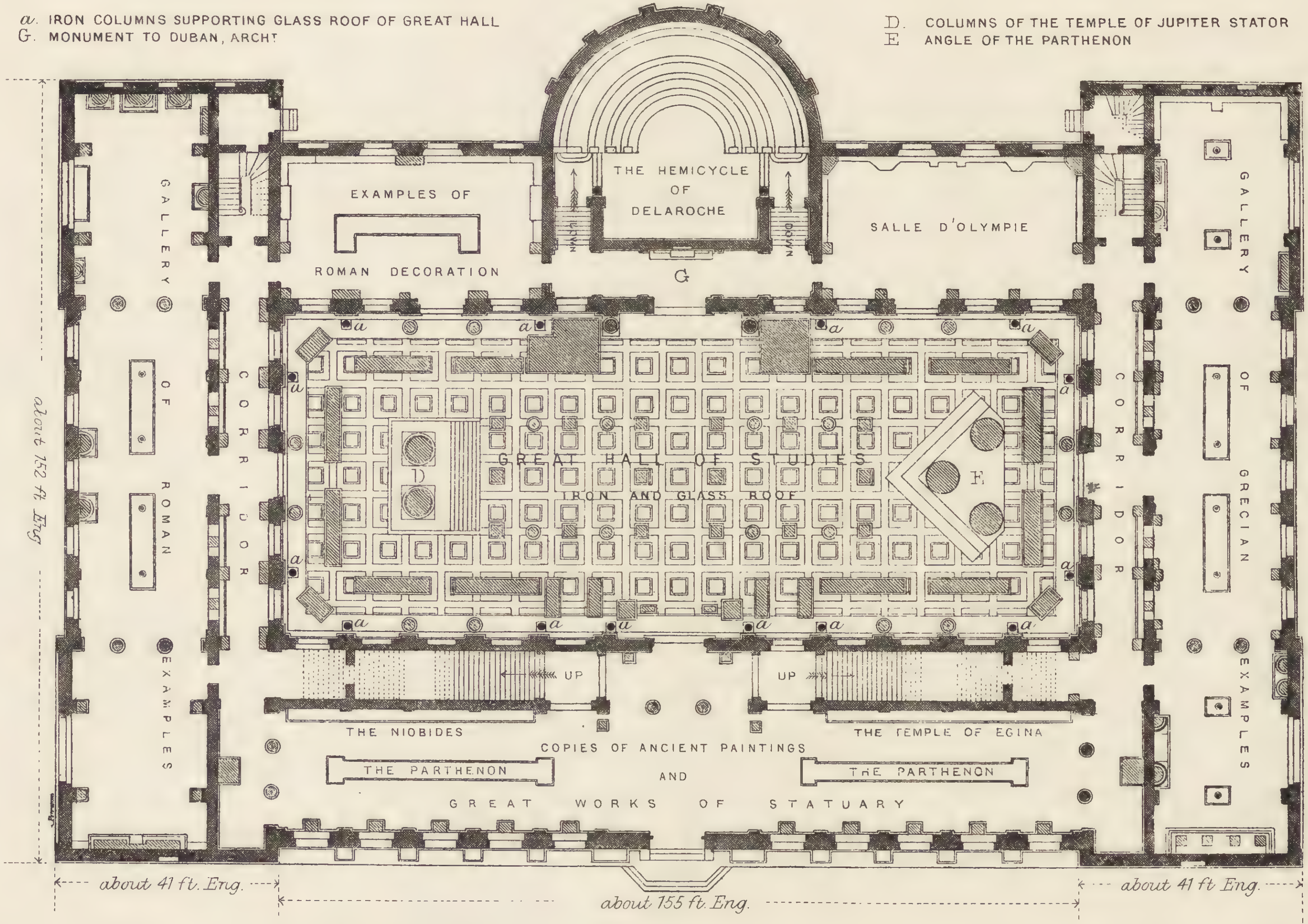


FIG. III. GROUND PLAN OF BUILDINGS AAAAA IN THE ÉCOLE DES BEAUX-ARTS.

(COMMONLY CALLED THE PALAIS DES BEAUX-ARTS.)

Extracted from the Encyclopédie d'architecture. 1876. p. 34.
See elevations and sections in same volume.

C.F. Kell, Photo-Litho. Castle St Holborn, London, E.C.

VII. THE FRENCH *DIPLÔME D'ARCHITECTE* AND THE GERMAN SYSTEM OF ARCHITECTURAL EDUCATION.

By R. Phené Spiers, F.S.A., *Fellow*.

[Read* on Friday, the 9th May 1884, Arthur Cates, *Member of Council*, in the Chair.]

THE latest regulations for the courses of study at the École des Beaux-Arts, and the qualifications for the *Diplôme d'Architecte*, have been recently set forth in the *Journal Officiel de la République Française*. The summary I propose giving will be in some measure the complement of the remarks I made in the discussion following Mr. White's Paper, when I confined myself chiefly to a description of an *atelier*, and the working out of the designs therein under the advice of the principal or *patron*. As the Diploma examinations can be passed only by those who have obtained certain *valeurs* or marks in the first class or upper division of the École des Beaux-Arts, I am obliged to describe the curriculum of the obligatory courses of study there before specifying those referring to the *Diplôme* alone.

The École des Beaux-Arts affords gratuitous instruction to all comers, French or men of any other nationality, between the ages of fifteen and thirty, on condition of their passing an examination. This examination takes place twice a year, in March and in July, and is divided into two sections: the first consisting of a drawing from the cast (either ornament or head of figure) made in the School in eight hours; of a model in clay of an ornament in bas-relief, also in eight hours; and of an architectural design to be executed from a programme given at the time in twelve hours. Those only who satisfy the examiners as to the first test can pass on to the second, which consists—1st, Of a written examination in arithmetic, algebra (including quadratics and logarithms) and geometry; 2nd, an oral examination in the same; 3rd, an examination in descriptive geometry; 4th, a written examination in history, followed by an oral examination in the same. Those who pass this second test become students of the second class of the School, and are placed according to the number of marks received in the examination.

The course of study in the second class consists of—1st, *Concours d'Architecture*, or competitions in architectural design; 2nd, *Concours* in construction, mathematics, &c.; 3rd, Drawing from the ornamental cast, modelling from the cast (bas-relief only), and drawing from the antique figure. The first *(Concours d'Architecture)* consists each year of the following courses:—

a. Six studies of the Orders or portions of the same to a large scale shaded in Indian ink. [In explanation of these studies I may note that it was found that many of the students entered the School with very little knowledge of the ancient styles of architecture, and very little power of drawing them; to remedy these defects the new regulations require drawings of detail to a large scale, shaded in Indian ink, such drawings including studies of the Orders, and of sundry details, as doorways, windows, cornices, &c. This obliges the student to be a good draughtsman, and to have some acquaintance with ancient architectural styles before he attempts to design.]

b. Six complete designs (plans, elevations, and sections), the original sketch being made in the School in twelve hours, and retained by the authorities. Before being allowed to compete in this course, at least two mentions must be obtained in the first course (analytical studies).

c. Six sketch designs finished in colours and made in the School in twelve hours.

d. Two studies in ancient architectural styles, the programme for which is set by the Professor of History.

The second series of studies consist of:—

a. A course of lectures in mathematics and mechanics, followed by an examination partly written and partly oral.

b. A course of lectures on descriptive geometry.

c. A course of lectures on stereotomy, surveying, and levelling.

d. A course of lectures on perspective.

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* At the fifth Meeting of the General Conference of Architects held in London from the 5th to the 9th May 1884. See also the Proceedings, 1883-84, page 175, for a report of the same.

These courses are accompanied by the requirement to make a certain number of *épures* or drawings in the *atelier*, illustrating the course, and followed in each case by an *épure* or a drawing made in the School, *en loge*, in twelve hours, and by an oral examination; and lastly,—

e. A course of lectures in construction, followed (at intervals during the year) by studies in stone, wood, and iron construction, sketches for which are made in the School in twelve hours, followed by a complete set of drawings in each subject, done in the *atelier* in fourteen days, and one "*concours de construction* "*générale*," in which the working-drawings for a building are worked out with specification complete as if it were going to be constructed, three months being allowed to make the drawings in, the original design being made in the School in twelve hours. A *vivâ-voce* examination of every student is held in explanation of the drawings submitted in each of the above *concours*.

The third series of studies consists of drawings from the plaster-cast of ornament, modelling in bas-relief from the cast, and drawing of the antique figure. Twelve hours are given for the execution of any one drawing or model, done at the student's leisure, and not necessarily in one, two, or three sittings. At least two of each of these are required to obtain the medal or *mention* necessary for passing to the first class, and the Professor of Drawing decides when the drawings or models are good enough to be submitted to the jury.

The courses of study thus cited take about three years to go through; that is to say, an average student giving all his time can obtain a sufficient number of marks or *valeurs* in three years to enter the upper school.

The recompenses given are:—

For the *Concours d'Éléments Analytiques* (studies of the Orders), half-mentions.

Projets rendus (finished drawings), whole and half-mentions.

Esquisses (sketch designs), half mentions.

Mathematics, descriptive geometry, stereotomy, perspective, third medals and mentions in each.

For construction, first, second and third medals and mentions.

For drawing of ornament, antique-figure, for modelling, and for studies of history, third medals and mentions.

The values of these recompenses in second class are:—Half or second mentions, 1 *valeur;* 1st mention, 2 *valeurs;* 3rd medal, 3 *valeurs;* 2nd medal, 4 *valeurs;* 1st medal, 5 *valeurs.*

To enter the upper class it is necessary to have obtained six *valeurs* in architectural design, medals or mentions in mathematics, descriptive geometry, stereotomy, construction and perspective; a medal or mention in drawing of ornament, modelling, and drawing of the figure.

In the first class of the School in each year the courses of study consist of:—

Six competitions in Architectural Design,—finished drawings (*projets rendus*).

Six competitions in Architectural Design,—sketches, design only (*esquisse-esquisse*).

One competition of Composition in Ornament. (Done in the school in seven days.)

Two competitions of Design in Architecture reproducing a style selected by the Professor. (The sketches for which are done in twelve hours *en loge* and the drawings made in ten days in the *atelier.*)

Two competitions in Drawing from the Figure. (Twelve hours each.)

Two competitions in Modelling of Ornament. (Two hours each.)

The recompenses given are:—

For Architectural Design, finished drawings,—1st medals, 2nd medals and 1st mentions.

For Architectural Design, sketches,—2nd medals and 2nd mentions.

For Ornament and Design in selected styles,—1st medals, 2nd medals, and 1st mentions.

For Drawing of Figure and Modelling,—1st medals, 2nd medals, and 2nd mentions.

The values of these recompenses in the first class are different from those in the second, and are:—1st medal equals three *valeurs*, 2nd medal equals two *valeurs;* 1st mention equals one *valeur*, and 2nd mention equals a half *valeur.* Besides these are the *valeurs* accorded to those who take part in the great competition for the *Grand Prix* described in Mr. White's paper, viz., being among the ten selected, two *valeurs* or marks, and in addition the following:—

First-second *Grand Prix*, four *valeurs* or marks; second-second *Grand Prix*, three *valeurs* or marks; mention, two *valeurs* or marks.

After these preliminary explanations, I am able to come to the immediate purpose of my communication, viz., the examination required for the *Diplôme d'Architecte.* The first examination was held in 1862, when five candidates passed; but it was not until 1869 that the formal decree of the Government instituting it was passed. No examination was held in 1871 (the year of the war), nor in 1873, 1874 and 1875—no candidates, I suppose, having presented themselves.

Up to the present time ninety-four candidates have obtained the Diploma,—by far the greater number being in the last four years.

The subjects given have been as follows :—

1869. A Town Mansion.

1870. An Academy of Music.

1872. *Salle des Pas Perdus*, or Great Hall of a Palace of Justice.

1876. A Residence for Three Artists : a Painter, a Sculptor, and an Architect.

1877. A Laboratory of Natural History on the sea coast.

1878. Four small Residences for a Tourist : one in Switzerland, one in England, one in Spain and one in Italy.

1879. A Carriage and Foot-passenger Passage through a Palace.

1880. A Hall for the Public Meetings of the *Institut National de France.*

1881. A Municipal Library for a large Provincial Town of France.

1882. A House for the *Société Centrale des Architectes*, Paris.

1883. A Concert Hall for a large Provincial Town.

The examination is held once every year.* No student can present himself as a candidate who has not obtained nine *valeurs*, or marks, in the first class of the School, either in architectural design, composition of ornament, or in the competition for ornament for the *Grand Prix*, and one mark in architectural history.

The subject for design consists of a building, or portion of a building, worked out with plans, elevations, sections, working drawings, full size details, and specification complete, as if the building were to be carried out, with a *devis estimatif*, or schedule of quantities, of one trade. Six months are given to work it out, the original sketch being made in the School. On the submission of the designs the candidates are required to pass an oral examination before their drawings on the various details there shown, the theory and practice of their construction, the qualities and defects of the materials employed, their strength and stability ; as also an oral examination on the history of architecture,—on the elements of physics and chemistry applied to construction,—on building legislation,—and on the system of accounts.

The judges consist of,—The Director of the School and the Secretary (M. Albert Lenoir) of the School ; the Secretary of the School Council ; the eight architect-academicians ; three professors of the School *ateliers ;* three professors of the external *ateliers ;* the professors of Construction, of the Theory of Architecture, of Physics and Chemistry, and of Building Legislation ; two members of the School Council ; an *Inspecteur-général* of Historic Monuments ; an *Inspecteur-général* of Ecclesiastical Buildings (*édifices diocésains*) ; and an *Inspecteur-général* of Public Works (*Bâtiments Civils*),—the last three nominated by the Government ; twenty-six members in all.

I am inclined to believe that the standard required to obtain the *Diplôme d'Architecte* is much too high, and in this idea I am supported by one or two French architects whose opinions I have asked. It means six or seven years' serious study in Paris, and the provincial architect is not able always to afford so long a period ; nor does his position or remuneration as "Architecte du Département" require or call for so searching an examination or such multiplied preliminaries.

So many years have passed since I examined in detail the working of the schools of Berlin, Munich, Vienna and Stuttgart, that I may not be now giving the latest developments. The papers of the examinations held in Berlin for the degrees of *Bauführer* (building inspector) and *Baumeister* (architect) show the very high standard (much too high I think in mathematics) required there.

In Germany, or rather in Prussia, the student comes from the university or school with a good knowledge of geometrical drawing, of drawing from the cast, and of mathematics and physics. He first enters the office of an architect for one year, where he picks up what he can, as in England. He does not pay anything, his knowledge of drawing and of descriptive geometry placing him in a position to be able to render assistance of value in return for the privilege of working there. He has then to pass a slight examination, and studies in the architectural school for two years. His attention there is turned to all the theoretical and practical points of the profession. He copies drawings made by well-known architects,—if at Berlin, chiefly Schinkel's and Stüler's,—and divides the time between making the copies and the composition of original designs (which are, of course, more or less *adaptations* of what he has learned in copying). He attends lectures on physics,

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* In 1883 the *diplôme d'architecte* was awarded to 24 candidates, 10 of whom were pupils of M. André, recently elected a member of the Institut de France (see foot-note page 101 *ante*).

mathematics, construction, ventilation and warming, sanitary science, the principles and practice of estimating, and *writing* specifications. At the end of the second year he passes an examination, and takes the title of *Bauführer* or inspector (if he fails to pass he continues his studies). If he aims at a higher position he obtains an appointment on some Government building as inspector or clerk (receiving a nominal salary) for three years, and then enters the school again in the first class to study for two years more, the studies being of a very advanced kind; at the end of that time he passes an examination as *Baumeister* (literally a "master of "building,") and he then becomes a Government architect, or practises on his own account. At Munich and Stuttgart, the capitals of Bavaria and Würtemberg, the practice still obtains, I believe, of studying one year in an architect's office before entering the architectural or polytechnic schools, as they are called. Two or three years are spent in the school, followed by examinations; I am not aware whether the examination is recognised by the Governments of those countries.

In Germany, architects and engineers generally study together in the same school; in France, architects, painters and sculptors.

In Vienna, architects have their special High School; there are Classic and Gothic professors, with their respective *ateliers* or studios, and in many cases the student passes from one to the other. There are complete courses of lectures, competitions in design, and examinations held at the end of each term, as in an English university or school. In 1863, or thereabouts, a new system of study was introduced which is worth notice. The senior students of the school, about twenty in number, make an excursion with their professor twice or three times in the year for a period of a fortnight or three weeks. They take up one or two important buildings and measure them, taking plans, sections, elevations, and details (very similar to the work done in some of the series of excursions organized and carried out by the late Mr. Edmund Sharpe with the Architectural Association). About £5 is allowed to each student by the Government, and his drawings become the property of the State. On returning to the school in Vienna, these drawings are worked out to a large scale, traced in lithographic ink, and reproduced, each student having a copy. Alternately with the making of these drawings the students work out designs of their own, and naturally these designs are inspired with that feeling which they have imbibed when measuring and drawing the ancient edifices of the country.

So many years are spent in the German schools in training that comparatively few of the students give any time to travelling. In Vienna, during one or two years after leaving the schools, the Austrian student travels through North Italy, and when the Quadrilateral was in the possession of Austria special facilities were afforded for the careful delineation of the finest works of the Italian Gothic and Renaissance styles. The superiority of modern architecture in Vienna to that in Germany generally I attribute to these travelling tours.

Before quitting the subject of foreign education, it will be interesting to note that in Spain, throughout the length and breadth of the land, no one can practise as an architect who has not received the diploma of the Architectural School of Madrid. Except that the examination, which follows after three or more years' studies in the school, is preceded by a serious test in mathematics and physics, I am unable to give you further information.

May I venture to draw a parallel between English and foreign architectural training? The first great failing in England is that the student coming straight from school is not prepared to make that use of the practical training to be had in the office which is universally assumed. He has little or no knowledge of either freehand or geometrical drawing, of physics, mechanics, or of any of the elements of architectural style; he flounders about, therefore, in the sometimes styleless design of the architect in whose office he may be placed, and acquires by the longest possible process a certain knowledge of a mixture of style and no style, second-hand; his powers of reasoning in design, as a rule, are not brought into play until his articles are terminated, and then want of time and absolute lack of training at once curtail his ideas and cramp his imagination. He has picked up an idea here and there in the office, and numerous details, but he finds himself unable to grasp the composition of a building of any size. In many cases he has never had an opportunity of visiting or studying any one of the buildings the drawings of which he has been continually at work on; and, therefore, supposing he has been thinking for himself, has never seen the results of his thoughts and inquiries (this observation applies more to London than to provincial students). He has, in fact, taken from *three to five years* to learn *imperfectly* what might have been learned in *one or two* if his mind had been *previously trained* to receive it.

If we turn now to France, we find that foundation of knowledge laid which is wanting in England. Before the student enters any office, his hand is trained to draw freehand in the primary schools, and his mind

developed with a knowledge of applied mathematics and descriptive geometry. He enters an *atelier*, and the elements of style are learned in the École des Beaux-Arts. Architectural drawing is carried to a high standard. Original designs are worked out, interspersed with instruction in construction of various kinds, and all the sciences cognate to architecture. The student works not so much in rivalry with his fellows as in *atelier* against *atelier*. This rivalry of the studios, which I described in the discussion following Mr. White's Paper, is the most important feature in French architectural education. The isolated effort of one individual in rivalry with another may,—nay, must,—continually fail, because the development of style is not, and never can be, worked out entirely by one man. An original genius suggests a theory, a second carries it a little further, by numerous others it is taken up, till at last this new idea becomes an established fact. A number of men working in one *atelier* form a school in friendly rivalry against others. Each student in it exerts himself to his utmost. The senior students advise the juniors in the study of their designs. The junior students in return work for the senior students, and acquire knowledge of style by so doing. The energies of both are brought into play, and this unison of feeling,—this mutual co-operation,—enables the student to acquire great knowledge of style, rapidity of execution, and a serious study of design in a short time. In this we find the secret of the success of the French school, so far as it goes. Where, then, does it fail? It fails because a studio or *atelier* is not an office where work to be executed is drawn out, or a *chantier* where it is being carried out. Those students whose means necessitate their working for their living whilst their studies are continued from time to time at the school do acquire that practical training which fits them for their vocation, and the most prosperous architects at the present day in France (and by prosperous I mean not those highest in rank, but who are the most sought after by clients), are not, as a rule, the past *Grand Prix*-men, but those who commenced their practical training at an earlier period of their existence. On the other hand, it must not be forgotten that the high standard of design which exists in France is due to those architects who, in one sense, have sacrificed themselves and their prosperity (so far as a large income is concerned) by continuing their studies till they had obtained the *Grand Prix*, and then devoting four years more to research and study in Italy and Greece. The important changes which have in late years been effected in the École des Beaux-Arts show that the Government is fully alive to the defects in its system of education, and the practical character given to the *Diplôme d'Architecte* may bring about an important change in the architecture of French buildings.

In Berlin this want of practical training is avoided by the student being obliged to study for one year in an architect's office before entering the school, and (if he aspires to the rank of *Baumeister*) by the spending of three years as inspector or clerk on Government buildings before he passes to his second and superior training in the school. Compared, however, with French education, the German fails in art because he is linked with the engineer instead of with the painter or sculptor, and, further, by working in one *atelier* (viz. the school) and under one set of professors, the rivalry lies between student and student, and not between *atelier* and *atelier*. Add to this that the custom (whether it continues or not I do not know) of copying eternally the designs of Schinkel, his ceilings, staircases, cornices, &c., cramps the German architectural mind, and prevents its emancipation into a freer line of thought and imagination.

Of late years in England an immense progress has been made, due chiefly to two causes:—1st. The great development of the practice of drawing and measuring ancient buildings encouraged by the rewards of the Institute, of the Architectural Association, and of the Royal Academy, and the subsequent reproduction of such drawings in the Architectural Association *Sketch-Book* and other publications, and in the professional journals; and 2ndly, the extraordinary enterprise shown in the publication of drawings of actual modern buildings and of competition designs in the professional journals of the day. Where all of them have been doing their best to supply a demand, it would be invidious to name specially any one of them, but there can be no doubt that the immense development and freedom of architectural design during the last ten years in England, and the rapid advance in draughtsmanship, is more or less due to the placing within the means of the poorest student a series of illustrations of the latest developments of architectural style.

Two other educational sources must here be noted:—1st, the meetings and classes of the Architectural Association, a society unique in its character, existing in no other country and in no other profession; and 2ndly, the Royal Academy, which, for obvious reasons, I should have refrained from mentioning, were it not to pay tribute to the services of those members of the Academy who, in late years, as Visitors, have given the students the advantage of their experience and of those other qualifications which have brought them among the elect. And here I venture to take this opportunity of rendering a personal tribute to the memory of one of our greatest artists whose loss we still deplore, the late Mr. George Edmund Street. The long experience I have had of architectural training enables me to judge, perhaps better than any one else, of the extraordinary value

of the service which Mr. Street rendered in the Architectural Class of the Royal Academy. The rapidity and range of his grasp of such subjects of design as were being worked out by the students, the wonderful fertility and originality of his mind, and the peculiarly happy way in which he (accepting the scheme of the student's work) turned it from bad into good architecture, and in a few minutes gave him the benefit of forty years' experience, promised to lay the foundation of a school of architectural designers in this country which would have left its mark in the architecture of this last quarter of the nineteenth century. His career as visitor in the Architectural Class was, alas ! too short, but the influence of his work remains with us; and among those who, in addition to his advice in the Academy, received their architectural training in his office, there are some who have already taken a foremost place in the profession, and others who are, I trust, destined to do so.

R. PHENÉ SPIERS.

[Remarks by the Chairman.]

I have listened with the greatest interest to the exceedingly able Paper which Mr. Spiers has read. It deals with a subject the importance of which it is hardly possible to over-estimate. Upon the education of the young architect depends the future of the profession and the honour of this country in the development of the art. It is much to be regretted that many of those young men now coming forward should be in charge of members of the profession who receive large premiums for what is too often only the run of the office. Mr. Spiers ably represents architectural education in England, but he has had also considerable knowledge and experience of Continental systems. He has dwelt upon the system prevailing in France, with the *atelier*, its *patron*, and the confraternity of students, assisted by the courses of study drawn up by the École des Beaux-Arts. A corner-stone has been given to this by the establishment of the Diploma, the possession of which is a certain guarantee that the holder has passed through a course of serious study, and has a sound basis of knowledge, not only as a draughtsman, but in all the arts and sciences which are cognate with and affiliated to architecture. The contrast between this and the English system is striking, and the only redeeming feature on the part of the English system appears to be the Architectural Class of the Royal Academy, of which Mr. Spiers is the honoured master. I cannot speak of my own knowledge of that Class, but speaking from what I have heard of the experience of my own pupils, I can cordially endorse what has been said with respect to the great influence and the devoted energy which our late President, Mr. Street, exerted in improving the efficiency of the Class. Nothing could render his loss more to be regretted by the profession than the fact that at the moment when he died he was developing in the Architectural Class of the Royal Academy, with the assistance of Mr. Spiers, a system of education likely to bring forward the abilities and skill of the young men in a manner which has never been attained in England before. All honour, therefore, to Mr. Street, and it is only to be hoped that the Royal Academy will continue to give Mr. Spiers every assistance in developing the system so well begun. I have been much struck with Mr. Burnet's drawings displayed on the walls, drawings which afford an apt example of the French method of teaching the art of delineating vaults and other constructional parts of a building in plan and section. I may incidentally mention that I was exceedingly surprized to find that the Secretary of the Institute and the editor of its TRANSACTIONS had found it necessary to append an explanation to the word "stereotomy" in the discussion on his Paper, which was referred to by Mr. Spiers. That one instance was sufficient intimation of the views which Mr. White held as to the want of knowledge of the architectural students in this country. As regards the French studio or *atelier* system, Mr. Burnet, the son of Mr. John Burnet, of Glasgow, affords a very happy instance of the advantages to be derived from the course of study which he has undergone at the École des Beaux-Arts. At an early age he has had an opportunity of showing in an excellent manner the advantages to be derived from a Parisian education in architecture. His natural ability has been developed and guided by his course of studies at the École, and those who visit Glasgow can hardly receive a greater pleasure than by inspecting a work by him, the Fine Arts Gallery in Sauchiehall Street. This is an excellent and admirable work, not only complete in all its parts, but showing the great advantages derived from such a course of study as Mr. Spiers has indicated. Mr. Spiers has shown that in this country the student has no satisfactory preparation for office-work. Too often the ordinary work of an office assists him but little, and the only opportunity open to a young man is in the competition for the prizes and medals offered by the Academy, the Institute and the Association, which, after all, only affect a comparatively small class. That class really does not so much need the inducement, as those who form it would by their own natural abilities and industry make their mark whether those prizes were offered or not. The Examination established by the Institute has done, and will do, great good, and I hope that one

of the practical results of Mr. Spiers's Paper, and of his efforts to improve architectural education, will be to enlarge the Examination and to give more force and power to it, inducing the Institute also as a body to take up firmer ground on that subject than it has hitherto done. With regard to the education of the architect, I may refer to the report of the International Congress of Architects held in Paris in 1878, in which *l'Enseignement de l'architecture* * is considered in an elaborate essay by M. Émile Trélat, Director of the École Spéciale d'Architecture, and one of our Hon. Corr. Members, who, however, draws a most important distinction between "*l'enseignement de l'architecture*" and "*l'enseignement de l'architecte de profession.*" It is not the teaching of architecture that specially concerns us; our object must be to advance the professional education of the architect, and to secure that it will enable him to meet the requirements of his professional life. I hope that the attention of the Institute will be directed to this matter, and that it will receive more encouragement from the senior members of the profession than it has hitherto done.

ARTHUR CATES.

[Remarks by Lawrence Harvey, *Associate.*]

I have had experience of the German system at Zurich under the late Professor Semper, Zurich being considered the best school at the time I studied there. Professor Semper is not unknown to the profession in England, because he taught for some time in London. The fault of the German system is that it is really a schoolboy system, the time being cut up into lessons, so that there is no "go" in one's studies. This is not only my opinion, but it was also the opinion of Professor Semper, who was, however, forced to follow the course laid down by the Swiss authorities, and could not change it. When I went to Paris I found a very different state of things. Instead of being in a big boy's school, where men from twenty-five to thirty were taught like boys of twelve, I found myself a free man without being subject to any system of school discipline. I belonged to the *atelier* of M. Le-Bas, one of whose pupils was M. Garnier, the architect of the Grand Opera House, and among other pupils were some who have since risen to great eminence. The great value of the *atelier* system is that every pupil feels that his success depends largely on his own industry and application to his studies, and not only his own success, but the *prestige* of the *atelier* to which he belongs. I remember that for one competition I worked for some three weeks until eleven o'clock at night, going back at four the next morning, while the last evening I worked all through the night. It could not be expected that a pupil in a mere school would work as hard as this; but a man who had all his initiative developed in himself would do so when prompted by the ambition of succeeding. This is the great advantage of such a school. Some years ago I travelled with Mr. Charles Barry in a railway carriage, and in the course of conversation Mr. Barry asked me for my experience of the École des Beaux-Arts. I told Mr. Barry that the pupils who paid the most at the *atelier* Le-Bas paid 21 francs a month, and these were the pupils who were not admitted into the School. When they were admitted into the School, they paid about 15 francs; when admitted into the first class 10 francs were paid; and any one who had received a prize, such as a medal or something of the kind, was not asked for any money by the *chef.* Mr. Barry asked what was the motive, then, for an architect keeping an *atelier?* I told Mr. Barry that, in the first place, Frenchmen were very different from Englishmen. A Frenchman believed a good deal in doing things for the sake of "*la gloire,*" and, besides, there was another motive actuating the *chef* of a large *atelier.* His position as such was one of the best steps towards getting to the highest honours France could give in architecture, namely, that of being elected an Architect-Academician, that is to say, a Member of the Institute of France. This is just what the architects in this country cannot aspire to, because the Royal Academy here has nothing to do with the profession. In fact, architects have not even the right of having an architect in the Royal Academy. Some days ago I asked myself whether the French system was really impossible in this country—whether something of the sort could not be accomplished here. In this country we have not got into the way of giving a motive to a man to be a good master to his pupils. At the present time there is no inducement, except to keep the pupils at work making tracings and other things, while the architect pockets the money paid by the parents and guardians. But I think I see my way to some remedy. In the Institute prizes are now given for different things, and then there is the Examination for admission as an Associate. What I suggest is that at the same time that they proclaim the name of the pupil or candidate who has succeeded in gaining a prize or in passing the Examination, they should also proclaim the name of his master. A great part of the merit of the pupil depends on his master; therefore it is an injustice if the name of the master is not made known. If this be done I believe we shall very soon find a

* *Congrès International des Architectes, tenu à Paris, du* 29 *Juillet au* 3 *Août* 1878. 8o. Paris, Imprimerie nationale 1881, page 154.

change for the better, and that, as in France, after a certain number of years some one will be found to have gained the name of being a particularly good master. Le-Bas's name seemed to be known all over the world, although he had done no very great work, with, perhaps, the exception of the Church of Notre Dame de Lorette. Le-Bas's name had been made, however, by his being a good master. There are many men with a particular aptitude for teaching who have not got the chance of designing a great building. From the simple fact of a man having a big building all the world talks about him, whether it be a good building or not; and there is no doubt that honours are given to those people who are successful in getting big buildings. They receive gold medals and are made knights, but this is merely fallacious, because a man like Christopher Wren required no "Sir" to be put before his name. I have had a good opportunity of seeing the influence which Mr. Street had over some of his pupils. I have seen the works of two young men who were pupils at the Royal Academy, which had been corrected by Mr. Street, and evidently he had inspired life into them, as will always be the case when an artist comes in contact with those aspiring to high aims in art. Supposing Mr. Street had been an unknown man, but had had pupils like these, and it was found that all the pupils who took the great prizes came from Mr. Street! Though he had been an unknown man we should, under the French system, have had an opportunity of seeing that he was doing a great public service, and we should recompense him by according to him the highest honours that could possibly be given to him. I consider, therefore, it is of the utmost importance to proclaim the name not only of a successful competitor but also that of his master.

L. HARVEY.

[Remarks by Professor Kerr, *Fellow.*]

It is a remarkable thing, when we contemplate the immensely delicate organization devoted to the study of architecture in France and Germany, that our English students under the English system seem, nevertheless, to find their way to design in their own fashion with great success. We have no school except the school of the Royal Academy; for South Kensington, so far as the teaching of architecture is concerned, is simply a farce. It is no doubt capable, under a better system—by dismissing the soldiers and admitting the architects—of being made a centre of architectural instruction which would be of great benefit to the public, and tend to the reputation of the country. The way in which the student obtains his knowledge of design in this country is now very simple. We cannot persuade young men in this commercial country to devote so many years of their time as seem to be devoted in France and Germany to the study of what is called Academical drawing. We take a different line. The student must begin business, and get business, however sublimated his ideas may be with respect to art. I do not think that the system of paying large premiums is so much encouraged now as it used to be, and for my own part I should be very glad to see it entirely abolished. I remember one architect who had a very considerable practice in his day, and was of high reputation—the late Mr. John Shaw, of Christ's Hospital. Mr. Shaw made it a rule never to take a penny from any pupil, but to admit into his office without any fee, and even on small salary if it were earned, any young man for whom he had a vacancy, and who displayed sufficient ability. That system is gaining ground in the case of many architects who do not take premiums. Those who are the most solicitous about premiums are the men who have the least to offer in return for them. The system of taking youths for three years, for whatever the master can get, is not to be commended. When a young man of artistic proclivities finds himself in the office of an architect in the country, with a fair general practice, what does he do? He devotes himself, supposing he be a steady youth, and anxious to learn, to his master's work. Then again, he has now a peculiarly English institution for his education, and that is the illustrations in the professional journals, to which it is impossible to attach too great importance. From those drawings, which are facsimiles very often, young men are able to obtain information, instruction, advice, direction—call it whatever you please—to a much greater extent than they could get in any School of Design according to the French and German systems. Therefore I think the professional journals are entitled to be called the architectural academy of the country. The profession, therefore, ought to be by no means stingy in its support of that particular institution, and in its acknowledgment to those who, by their commercial enterprise, are being of great service to the education of the profession. In Mr. Spiers's very admirable Class at the Royal Academy, a young man has to go through a regular course, which is of great value. I should like to see a similar school established in connexion with the Institute, and also one forced upon South Kensington. We pay for it, and we ought to have it. It would be well to see a rivalry spring up between the Institute, the Academy, and South Kensington, which would very soon produce a good effect. The English architectural student educates himself in a way which must be called "rough and ready," and he fails in attaining that

peculiar delicacy of delineation for want of this particular academical training. Therefore I hope that amongst the other indications of progress which the Institute is presently about to afford, there may be some suggestions made as to the foundation of a school of academical architecture. If we look, as we have to do once a year, at the drawings and designs sent in to compete for the Institute prizes, it is useless to say they are not first-class productions. They are not of the same style as the designs, exhibiting draughtsmanship of a high order, exacted by the French; but from our point of view nothing can be better than some of the drawings which are hung in our rooms. Therefore I for one am very much inclined to think that if we are allowed in England for the next twenty or thirty years to pursue our own course, without too much influence from abroad, England will be one day found at the head of all the schools of architectural design in the world. No one can look back to the last fifty years of English history in architecture without being satisfied that we are pursuing a course that will end in our ascendancy in this as in many other things.

ROBERT KERR.

[Remarks by R. Knill Freeman, *Fellow.*]

It would seem that the outcome of the French system is to develop the more artistic part of professional education, while the German system produces a "cast-iron" development of it. Any one who has studied the question of professional education during the last thirty years will see that one great danger is the separation of the theory from the practice of architecture. A short time since remarks were made in the building papers as to the great difficulty which assistants experience in meeting with adequately-paid appointments. I do not dispute that there are great hardships and difficulties, but my own impression is that in England a good man in the long run will always make his position and command his price. With regard to the question of education in this country, it has to be looked at from two points of view; we have to consider the education of the profession generally, and anything done with that in view, of course, must have its centre and principal movement in London. But in seeking to be generally advantageous we must have such appliances for the use of the students of the profession as will bring them within the reach of all. One of the great difficulties in England in any attempt to adopt the Continental system will be in the long term of residence which seems to be required to carry out the system. In England, when a young man goes into an office as a pupil, he has more than one thing to consider. In the first place, he has to consider his education; and in the next place he has to consider any position he may have in the district which he inhabits, and which he wishes to keep up. The fact of a provincial man being away for some years in London, or elsewhere, will very much shake and weaken that connexion, and I fancy that although a good education would be of great advantage, the dropping out of the minds of those amongst whom he hopes to practise would be a very great drawback. The chief movement in this matter must come from the societies, and first from the Institute. If some arrangements were made for art-education in the principal centres of the profession, by which provincial students might obtain very different privileges to those which they now possess, a great step would be made towards the object in view.

R. KNILL FREEMAN.

[Remarks by John Slater, B.A., *Fellow.*]

The whole feeling in this country is against centralization, and against depending too much upon authority. We are so anxious and desirous of fostering and giving scope to individual genius that we very much prefer that it should run into individual eccentricity rather than be "licked into shape." Could we have had a more typical English speech than that of the learned Professor? In this country the student, unless he has some one to look after him carefully at first, does not know where to go for information. I agree with what the Professor has said as to the excellence of the designs which are sent to the Institute, and those which appear in the building journals. Good men, no doubt, who have a natural ability and genius, get on, in spite of everything, but they take a great deal longer to attain the knowledge required in their practice than if they had been able to make use of such means as are to be had abroad. I do not advocate a servile imitation of the French, German, or any other continental system, but I think we ought to make careful inquiries, and ascertain what other countries are doing in this respect, and how they do it. We ought not to be above learning from them, and I may add, with all possible respect, that if the advice of Professor Kerr is followed—to pursue our own course confident that all will come right in the end—much harm will result. At a previous meeting of the Conference reference was made by Mr. Cates to several French books as being the best on their respective

subjects, and this shows that some incentive should be given to architectural students in this country to make themselves acquainted with other languages than their own. To a very large number of young architects these are simply sealed books. Last year the Board of Examiners made a recommendation that in the Examination there should be some questions showing the knowledge of foreign tongues possessed by the candidate. The Council, however, did not see their way to comply with the request, but I venture to hope that the Council will yet consider whether the scope of the Examination should not be more extended. I think that while examination in France is rather too difficult, we at present err on the other side.

JOHN SLATER.

[Remarks by Charles Aldridge, *Fellow.*]

As a provincial architect I would like to say something about pupils in the provinces. I would also like to add my meed of praise to Mr. Spiers for the able Paper he has read. The difficulty is to see how best to commence the necessary reforms, and how they can be effected under the present system of pupilage. For my own part I would like to see that system altogether abolished; but something must take its place, and at present there does not seem to be any indication of what that something should be. At present parents have a notion that when their son leaves the office in which he has been articled, he will be at once able to place his brass-plate on his door, and make a fair income from his own practice. That idea not only affects the parents, but also the pupils themselves, for they are more or less permeated with the notion that, when leaving the office of the architect to whom they are articled, they will be able to start for themselves. It is next to impossible to get them to attend classes or lectures after office hours, which they would do if they knew they had to pass a compulsory examination at the end of their term of pupilage. In Liverpool I established classes in connexion with the Liverpool Architectural Society, somewhat on the same principle as those in connexion with the Architectural Association in London. These were more or less successful, and I then endeavoured to establish a place where lectures could be given on practical subjects. But two or three of these lectures were delivered to almost empty benches, and the result was that they were suspended. I can hardly blame the young men in this matter; they work more or less hard in the office all day, thinking there is nothing more to be done to acquire efficiency. There is, however, evidence of system in the education obtained abroad. The architectural books of foreign countries are far superior to anything in this country, and there is a thoroughness in them not to be found here. In England much is lost by this want of system, and until there is a really compulsory examination for architects, talk on the subject will have but little practical effect.

CHARLES ALDRIDGE.

[Remarks by Edward A. Gruning, *Fellow.*]

I have been a little amused by hearing of the existence of a "School of Architecture" at South Kensington, for I have had many applications for assistants' berths from young men who have studied there, but not one of them seemed to know even the size of the common brick in use in London. That is an absolute fact which has occurred to me more than once. The few other schools in London cannot be too highly valued. A pupil has the opportunity of learning general and good practical work in the office where it is carried on, but in no case can he obtain in an office the education to be had at such schools as that of the Royal Academy. The want of this in my time was bitterly felt, but this is now well supplied under the leadership of Mr. Spiers. The value of the work done by the Architectural Association is, in my opinion, almost equally great. I observe that every day in the case of the pupils in my office, whom I try to bring up to practical work, but whom without the assistance of these schools I should fail entirely to educate, in the proper sense of the word.

EDWARD A. GRUNING.

[Reply by R. Phené Spiers, F.S.A., *Fellow.*]

I hope that the proceedings of this Conference will have some influence on the extension of our examinations, to make them wider of application. I do not wish them to go to the same extent as foreign schools, although no doubt they ought to develop a higher standard. It will be seen at once how that portion of my Paper referring to the rivalry between studio and studio has been taken up by my friend Mr. Harvey, who speaks of the "*Atelier* Le-Bas" as producing the best architects. For myself, of course, as a pupil of M. Questel, I speak of the "*Atelier* Questel" as being the best. When I first went to Paris to study as an architect, my father said, "Let us see first at the School whence the largest number of medallists have come," and, consequently, I went

to M. Questel's *atelier*. Prior to that I am aware that M. Le-Bas was the best, but the sun of both of them having set, M. André is now to the fore, and in consequence partly of the numerous mentions of students of his who have obtained diplomas at the examination, he has been elected member of the National Institute. This illustrates the great value of the rival *ateliers*, which we can never hope to have here, except in a sort of indirect way. I hope the pupils of Street and Burges in by-gone times, and of such living men as Waterhouse in the present, will take a certain pride in their schools. I know that the pupils of Street had the greatest affection for their master, and often speak of the advantages they gained in his office. With regard to the new departure which has been taken in France, though they have established *ateliers* in the schools, there are many outside, so that freedom is not so much lost as Mr. Harvey thinks. Professor Kerr is willing to be content with our own system; but for myself, I am not quite inclined to acquiesce in the continuance of things as they are, for I think we have much to learn from France and Germany. I feel certain that the most eminent men of the "Queen Anne" school are the greatest admirers of the four great architects of France—J. L. Duc, Duban, Vaudoyer and Labrouste. I think that if there is any decided tendency in classic design at present, it is towards a close assimilation of modern French work. Professor Kerr has referred to the architectural school at South Kensington. The reason of its failure and the failure of other similar schools there is, that they are not established to train artists of any profession, but masters of schools, and it will take many years before they arrive at any other results under the existing system. It is only necessary to go through a course which enables men to obtain appointments as masters to teach others, and the training in the architectural school is just sufficient to enable a man to teach the elements of construction and what is known as architectural design to others outside—just sufficient to teach a working man when he goes into the provinces. They are always obliged to get their ultimate training elsewhere. Mr. Freeman seems content with English draughtsmanship, and thinks we have a very high standard, but he does not agree with the theoretical instruction abroad. He failed, as perhaps I have done, in making it clear that though it is theory which is taught in the French schools, the theory taught is the theory of construction in its most extended branches. A French student has to go through a training in descriptive geometry and stereotomy which is quite unknown to English architects. Any one who goes through that cannot help reaping an advantage from it. I do not wish to suggest that such a man would have any exceptional powers. But I may remark, as an instance, that though unacquainted with practical work, when I returned to England I was working on a large building under Sir Digby Wyatt, and some of the ceilings of staircases were of complicated construction in different forms of Roman type. Though, of course, they came in very easy to me as part of the study I had gone through in France, yet I was astounded to find that the measuring surveyor had to come to me to know how the forms were developed, and could not get out his quantities without my assistance, from my knowledge of the method of setting out this particular work. We have in England a most excellent school of draughtsmen, who have arisen within the last few years, but notwithstanding their draughtsmanship, they are indifferent designers of plans. In France they lay great stress on the study of plans, but when this study was attempted at the Royal Academy Mr. Street found out that it was difficult to teach the pupils to draw large plans, and so he confined them to elevations. That is one of the difficulties we find in architectural students from want of previous training. Referring to the absence from provincial towns of the means of proper training, my experience leads me to expect better training in students from the provinces, and especially in those from Scotland, than in those from London. In the country the pupils have the advantage of seeing the buildings carried out which they have been working upon. They have to take up a larger area of more varied work, and they have more varied practice than Londoners, who are frequently engaged in the carrying out of one or two large buildings. Provincial men must, therefore, not despair, as their pupils are better trained than London pupils. Mr. Aldridge has spoken of the difficulties of pupils in the provinces, and there can be no more eloquent description of what is required. I am sure Mr. Cates must have listened with great interest to this discussion, because it points with great force to the want of examinations. A man will go through the fullest education in order to prepare himself for examination The lawyer knows he must pass an examination, and if the architect knew that he would have to do so he would read up works on various subjects, and in every possible way prepare himself to pass the ordeal successfully. The student would take an interest in preparing himself for examination, seeing the ultimate result to be attained. No one has referred to one portion of my Paper, the importance of some training before young men enter an office. What kind of training is there for them in London? I am inclined to recommend King's College and University College, and I cannot see why parents should not insist on their sons spending some time in obtaining that class of instruction which is obtained in the German Gymnasiums. There are some public and private schools which are moving in that direction, and, as time goes on, the necessity of teaching technical science in finishing schools will become more apparent. At present, at King's College and

University College, we derive instruction in some of those branches which are taught at the Polytechnic schools in Germany and the École des Beaux-Arts in Paris. In Manchester, we have Owen's College, and in Leeds and other large towns there are technical schools where those who intend to become architects could get their early training. It would be of the greatest value to any student if he could go through a course of training in the practical work of the workshop. All this would fit him for understanding and appreciating the work of the office. The great trouble we have to contend with under existing circumstances is that the student works three or four years without understanding what he is doing, and finds he might have learned in half the time if he had gone through the necessary preliminary training before he entered an architect's office. He not only takes five years to do what might have been done in three, but he fails to get as much out of his master as he might have done. My advice to pupils in an office is that the sooner they begin to design the sooner they will begin to work. It is of great importance that the pupil should know first of all what he has got to do, in order to train himself for a definite result. He should exercise his powers of design and get the best training he can, and that will ultimately result in presenting a training superior to that of any foreign school.

R. PHENÉ SPIERS.

*** In the course of the discussion of Mr. Spiers's Paper observations were made by several members, but of too brief a nature to be inserted as paragraphs of remarks. A wish was expressed by E. G. Bruton, *Fellow*, that means could be adopted for affording pupils the opportunity of passing through some such schools as those described. William Woodward, *Associate*, thought that constant visits to buildings in progress were of the utmost importance. G. H. Blagrove, *Associate*, considered that, as a general rule, a pupil in an English office got on rather in spite of his master than by any assistance he received from him. Hugh McLachlan, *Associate*, said that the German system had hardly had sufficient justice done to it by Mr. Spiers. It did not lead to so much of that beauty of drawing which was produced by the French system, but it was more practical in its results. Herr Franz Baltzer (a government architect of Berlin) remarked that in his opinion the examinations for architects in Germany were too exacting, especially in regard to the scientific portions.

VIII. PRECAUTIONS TO ADOPT ON INTRODUCING THE ELECTRIC LIGHT INTO HOUSES.—By Mr. Killingworth Hedges, A.M.Inst.C.E., Member of the Society of Telegraph Engineers.

[Read on Monday, 18th February 1884, David Brandon, F.S.A., *Vice-President*, in the Chair.]

THE electric light has already been introduced to the notice of the Institute of Architects, in May 1881, in an able paper by Mr. Slater,* who supplemented it with another communication which was read in May 1882. Since these were written great progress has been made in what perhaps may be fitly termed the commercial application of the electric light, which, in spite of assertions to the contrary, is rapidly extending, both for public and private use. Some disappointment has been expressed at the very slow progress of the much talked of schemes for the general distribution of electricity throughout our cities by means of central generating stations, from which the electric mains were to ramify, so that our streets and houses could be lighted in a similar manner by electricity as they are at present by gas. To facilitate this, the Electric Lighting Act, dating from the 18th August 1882, was passed; and in consequence of this power twenty-three applications for provisional orders were made in 1882 by various local authorities, and one hundred and six by electric lighting companies. The promoters of these orders were in most cases rather before their time, in that they neglected to sufficiently weigh the many questions incidental to the commercial application of a new illuminant like electricity. The stringent regulations of the Board of Trade have caused a temporary check on their operations by preventing the introduction of capital which might have been profitably employed. That the question of cost does not altogether prevent the adoption of a superior means of lighting is very clearly proved by the increasing number of occupants of houses who, after waiting in vain for electricity to be brought to their doors, have determined to produce it themselves, and for this purpose have set up the necessary plant.

There is a so-called novel plan for supplying electricity by means of batteries which it would be well to briefly notice before proceeding to describe the manner of applying the electric light to a house. Electricity for lighting purposes can be obtained by chemical action for which purpose an arrangement of a voltaic battery is sometimes used, and the combination of cells is termed a "primary battery."

There is little novelty in the idea of using the electricity produced by the consumption of a metal, which in most cases is zinc, in a battery to produce light. The difficulty experienced with the old form of battery was first one of expense, and secondly, the impossibility of keeping a sufficiently constant current to produce a steady light.

The inventors of the batteries which have been recently introduced claim to have overcome these objections, and say that a steady light can be maintained at a cost not much in

* See the Transactions, 1880-81, page 193; and 1881-82, page 201.

excess of that from a dynamo. The most successful of these appears to be that invented by Mr. Ross, whose battery is a modified Bunsen, using zinc carbon plates of large size. He claims to have got over the polarizing difficulty, and is able to produce a steady current for a period of twelve hours without recharging.

For small country houses such a battery may be successfully applied, but in most cases a large number of lamps would require a battery of great bulk; and it would be more economical to produce electricity mechanically; that is, by converting the energy of the prime motor into electric force by the use of the dynamo machine.

Motive Power.—The manufacture, if it may be so termed, of electricity is far easier than gas, in that no special position or site is required for the generating station, which may be small or large according to circumstances. With a private gas works it is necessary to hide the unsightly gasometer and to remove the works to a place where the smell will be least objectionable. With electricity the first requisite is a source of power which may be obtained either by steam, water, or gas. Therefore the special circumstances of the case determine the site of the dynamo.

In town houses a gas motor is as a rule the best, in that gas is always to be had, and a gas engine can be fixed in a very out-of-the-way position, such as the cellar under the street. Although more economical than a small steam engine, a gas engine is open to many disadvantages. It requires attention at regular intervals, and must be well balanced and fitted with a governor which will allow it to take gas after every few revolutions, otherwise if the load is small the lights will be affected each time the explosion takes place in the cylinder. Great improvements have recently taken place in the governing arrangements, and both the principal makers of gas engines are willing to specify perfect regularity for electric light work.

In country houses all three sources of power have been employed; the first house lighted was by water power which actuated a turbine.

Although the simplicity of hydraulic machinery leads one at first to recommend hydraulic power as the best motor for dynamos, the first cost is higher than with either steam or gas. The turbine which works the electric machinery at Sir William Armstrong's house at Craig-side has been often quoted as an instance of the simplicity of the installation, which is in fact part of a most careful arrangement of artificial lakes and cascades, without which the necessary fall from the brook could not have been procured.

Where a good fall is not available it is far better to set up a steam engine at some convenient distance from the house, either in connection with the stables or farm buildings, so that the steam power can be utilized when not required for lighting. The engine and boiler should be of the simplest and strongest kind compatible with economy in working, and should be in duplicate; all working parts should be got at easily, and be fitted in such a manner that they could be removed by an ordinary under-gardener or intelligent labourer. Practical experience shows that such men make far better electric-light hands than the amateur electrician who always wishes to improve his knowledge by experiment, generally by making additions which the owner of the house soon finds are greatly to his disadvantage.

As a rule there would be no gas in a country house where the electric light is adopted,

though strangely enough some of the first houses to use electricity have their own gas works. If such is the case ordinary coal gas can be dispensed with by using Dowson's gas, a brief description of which may not here be out of place.

The process of making this gas consists in passing a mixture of steam and air through a mass of red hot carbonaceous fuel. The steam producer and super heater consists of a long circular coil of steam piping through which water is passing continuously at a pressure of 25 to 40 lbs. per square inch. The water is usually drawn from an overhead tank, but an accumulator or feed pump can be employed. The quantity required is small, being only seven pints per 1,000 cubic feet of gas produced. The generator has an iron casing to make it gas tight, and this is lined with ganister to prevent loss of heat and oxidation of the metal. The fire rests on a grate, under the latter is a closed chamber into which a jet of super-heated steam plays, and acting as an injector it carries with it a current of air. The pressure of the steam forces the mixture of steam and air upwards through the fire, so that a high temperature of the fuel is maintained while a continuous current of steam is simultaneously decomposed. The following is taken from the official Report of the Smoke Abatement Exhibition Committee, on the test of a 3½ horse-power Otto engine worked by Mr. Dowson:—

Time occupied to get fire of generator (A size) in working order, thirty minutes.	
Anthracite (Trimsaran) consumed per 1,000 cubic feet of gas passed into holder, exclusive of gas used to heat steam super-heater	12·13 lbs.
Ditto, after allowing 100 cubic feet per hour for heating of steam super-heater .	13·17 lbs.
Otto engine worked with Dowson gas developed 4·41 indicator HP., and 3·26 brake HP. when making 156 revolutions per minute.	
Gas consumed per indicated HP. per hour	110·34 cubic feet.
Ditto per brake HP. per hour	149·30 cubic feet.
Fuel consumed per indicator HP. per hour	1·45 lb.
Ditto per brake HP. per hour	1·97 lb.
The cost of the Dowson gas was estimated by Mr. Clark at 50 per cent. less than coal gas at three shillings per 1,000 cubic feet.	

Since this report Messrs. Crossley have worked two gas engines of twelve and sixteen horse-power at their works continuously, and state that the average fuel consumption determined is 1·3 lb. coal per indicated horse-power per hour. It is needless to remark that this result is almost unprecedented even with the most efficient steam engine. The Engine House would contain the dynamos for generating the electric current. These should be fixed on wood to electrically insulate them from the ground, and should be so arranged that they can be moved in a direction to allow of tightening the driving straps.

From the dynamos or dynamo the current should be taken to a switch-board, which is a simple apparatus on which all connections are made with suitable arrangements, so that either one or more machines can be made to deliver into the same conductor. If secondary batteries or accumulators are employed, the current from these will join on to the same board, thus enabling the working current from the supply of the house to be either drawn direct from the dynamo or from the batteries. Another connection on this board admits of an instrument for measuring the strength of the current to be fixed in such a manner that it can be read by the attendant by turning the handle of a switch. From this switch-board the mains go to the

lamps, starting as a large cable which ramifies away like the gas main into smaller mains and branches, until each incandescent lamp is reached. [Illustn. xxviii, figs. 112, 113].

The system of distribution almost universally adopted for houses is that of lighting by incandescence, and fixing the lamps in parallel circuit or multiple arc, which has been illustrated and described in Mr. Slater's paper of 1882. At the date when that was written, however, it was thought impossible to regulate the number of lights in circuit otherwise than by putting in or cutting out resistances into the exciting circuit of the machine, a practice necessitating the use of resistance coils which often caused fires.

Self-Regulating Machine.—A process of evolution has brought forward a machine known as the Compound Shunt, which in a simple manner fulfils all the requirements hitherto only carried out by the dangerous resistance coils.

It is of supreme importance in electric lighting that the electric current should always be uniform at all times in each individual part of the work, and unaffected by changes in other parts. That is to say, each lamp requires a fixed current to work it; the lighting up of other lamps must not deprive it of any of its current; the sudden turning off of a number of other lamps must not send such excess of current into the one left, as to press it beyond its powers of endurance which might destroy it, nor should there be any fluctuation of the light. Let us assume for the convenience of figures that the full work is 100 lamps in multiple arc, each of 100 ohms, and requiring one ampère current. This gives a total resistance of two ohms, assuming the external work and resistance in the machine are equal, and an electro-motive force of 200 volts. When all but one lamp are turned off there would be a current of two ampères passing through it, which would heat the carbon filament to four times its proper temperature, and cause the lamp to flash up from 20 to, say, 160 candles, so that it would be probably destroyed. With the compound shunt machine the electro-motive force is practically constant, so that, if such a machine were used, no difference would be perceived in the lamp left if the 99 lamps had been turned out.

In this respect the regulation of the electric supply is more perfect than that of gas, with which illuminant, however, an excess supply occasions nothing worse than a roaring burner and great waste. To prevent this a governor is used which does not always came into action until after the evil has occurred, while with the self-regulating dynamo the evil is prevented.

The honours of the invention are claimed by several practical workers in electricity here. For instance, a highly-successful form of compound shunt machine may be mentioned, designed by Messrs. Crompton and Kapp, who have greatly increased the efficiency of the Bürgin dynamo, while Dr. Hopkinson has not only greatly reduced the manufacturing cost of the Edison machine, but has increased the commercial efficiency some three per cent. The actual efficiency of the improved Edison-Hopkinson dynamo is now 94 per cent., and the commercial efficiency 88 per cent.

To enter into a description of the different systems possessing these advantages, and the relative merits of each, would be beyond the scope of this paper; the author therefore proposes to describe some of the principal features of a supply of electricity and to point out the precautions necessary to its safe introduction and the prevention of fire risks.

In the first place, to understand what this electricity is we must disabuse our minds of that "invisible subtle fluid," which we use with impunity for ringing bells and actuating

telephones, and also take into our houses without any thought. The electric current necessary for lighting purposes, when uncontrolled, is far more dangerous; at the same time, if properly installed, it is rendered as harmless as that from the galvanic battery, with which we are all more or less familiar. The supply of electricity which may be furnished by any of the various systems differs somewhat in electro-motive force, or, as it may be termed, electrical pressure, according to the construction of the generating machines and the resistance of the incandescent lamps, the light from which is only the electrical energy in the form of "heat" in its right place; and the only source of danger is that this heat may be developed where it is not wanted, and thus cause "fire." This possible danger from the use of the electric light has already occupied considerable attention both in this country and abroad.

A special Fire Risk Committee, appointed by the Council of Telegraph Engineers and Electricians was formed in 1882, and some excellent rules were drawn up which have been adopted in a modified form by some of the Insurance Companies, and also by the Board of Trade in their "model order." Neither these rules, which will be found *in extenso* in the TRANSACTIONS of your Body 1881-82 (p. 232), or the "standard of requirements" employed by the New York Board of Underwriters, can be said to embrace all the changing details of an electric light installation, which can only be arrived at after the electric light has worked a sufficient length of time, and has been generally distributed like gas. With a view of eliciting further discussion on the subject, I propose to offer a few general remarks as a small addition to what has already been put forward by the Fire Risk Committee.

The first source of danger to property is in the mains and branch wires which conduct the electricity from the engine house to the incandescent lamps, which are distributed over a house in much the same manner as gas. If these conducting wires are of sufficient proportion, and of a material whose resistance is uniform, the current in its passage will not develope any injurious heat, and there will be no risk from this cause. Whatever resistance there is in the conductor, will cause a corresponding development of heat, which will vary with the amount of electricity passing, and inversely as the sectional area of the conductor.

The energy needed to cause the supply of electricity to go through the conductor is called the electro-motive force, and, although this has been compared to the difference of head of water necessary to cause a quantity of fluid to overcome the resistance of a pipe, the action of electricity in passing through a conductor is not the same. It more resembles water soaking through sand, in that the whole of the cross section of the wire interposes a resistance which, in large conductors, doubtless varies proportionately to the temperature of each section, according to its distance from the outside radiating surface.

Commercial copper, which is the material used for the conductor, is never absolutely pure, but can be obtained as high as 96 to 98 per cent, and as its resistance depends on its purity, a short length of inferior wire may upset calculations based on a superior quality, and cause that particular section not only to become dangerously heated but also diminish the supply of electricity, and there will consequently be a waste of power.

Copper is always used for electric lighting purposes, firstly, because it can be obtained in a purer state than any other available metal, and secondly, because next to silver it is the best conductor of electricity.

Safe area of Conductors.—The first cost of the electric mains being high, the tendency will

be to use conductors as small as possible, compatible with the electro-motive force required; the most economical proportion being that in which the annual cost equals the loss by heat caused by the resistance of the cable to the passage of the current. The householder has only to do with comparatively small currents. Nevertheless, it may be interesting to mention that the Board of Trade rule, for the service lines in the street, is 2,000 ampères per square inch of section where the current does not exceed ten ampères, and probably this limit will never be exceeded in the mains. It is found that when insulated copper cables are employed for the transmission of currents which exceed 1750 ampères per square inch of section, the diameter of the conductor should not exceed one inch, otherwise the heat cannot escape in proportion to the sectional area, and the insulation may be destroyed. For the conductors in a house, not more than 700 ampères per square inch of section should be allowed. The American rule for arc lighting is, "that the weight of the conductor per foot should equal that "of the wires or parallel circuit of the regulator of the electric lamps, or of the armature of the "machine, whichever is largest."

Having examined the proportion of the electric conductors, the question arises as to what will be the effect of a stream of electricity continually passing.

If heating goes on to any large extent, a change in the conductivity of impure metals may take place; but even then absolutely pure copper is apparently unchanged.

Copper wire taken from the coils of dynamos has been found to be brittle, and this has been principally noticed where alternating currents, have been used. In order to see whether the passage of an ordinary electric lighting current had any effect on the conductivity of a copper cable through which it had been passing for a considerable period, I have recently tested a conductor through which a current of ten ampères with an electro-motive force of 1,000 volts had been flowing for nine months, say about 1,600 working hours. After comparing its resistance with that of a new cable of similar length and design, the conductivity showed no difference, so it may be concluded that the copper had undergone no alteration. The time was short; also the current, 10 ampères, was only about one-fourth of that which might have been used under the Board of Trade rule, which for a current of 10 ampères is 2,000 ampères per square inch of section of cable.

Electrical Connectors and Joints.—Special attention should be given to these, in which may be included, not only all the joints where the branch wires lead off, but also the connections made with binding screws. Besides causing resistance in the circuit, bad contact between a wire and a terminal will produce heat; therefore, the area of the contact piece should be of sufficient size. In the case of a sliding connection, as that in a switch, some means ought to be provided for taking up the wear, and firmly pressing the surfaces together. If a spring is used, care should be taken to see that it is not softened by the passage of the current through it; and if the instrument is placed out of sight, or likely to be used by unskilled persons, it should be fitted with a self-acting arrangement, to render it impossible to leave the contact partly on, and cause a dangerous arc to be formed. The joints used are most important factors in the safety of an electric light installation; a faulty junction may upset the calculations made for the current to be taken by an otherwise efficient cable, in that heat may be developed. Solder alone should never be relied on for electric light joints; if ever a little heating takes place the solder may be softened by the action of the current which

tries to reduce the alloy into its constituent parts, thus allowing the copper wires to separate, and dangerous arcs to be formed, which will speedily destroy the cable. A joint must be made mechanically perfect, and considerable pressure used to unite the surfaces; the solder may be then applied to keep the whole air-tight, but in no case should any joints be made except by skilled workmen having previous experience in electric light work. [Illustn. xxix.]

Short Circuit.—The term explains itself and means that the current, instead of going a circuitous course, takes the shortest path, where, having no work to do, it causes fire. The greatest care is required when running electric wires to prevent this, which may possibly occur in one of the three following ways:—

1.—One of the conducting wires may either come directly in contact with the return conductor, or the staple which fastens the two wires may cause an electrical connection.

2.—Some good conductor may momentarily touch the unprotected surfaces of two wires, and cause an arc to be formed between them; or either one of them may, from a similar accident, be put in circuit with the earth.

3.—The same result may be accomplished by water dripping from one wire to another, by moisture on a non-conductor, or by either of the wires being immersed.

Accidents have occurred from each of these forms of short circuit, which are nearly all unlikely to happen as long as the insulation of the wire remains perfect. There is one exception, and that is where water is the cause, for then only some impervious material, such as gutta percha, will be a sure preventive. The so-called fireproof insulations are useless if they are not waterproof; even the lead tube covering for wires, which has been so highly recommended, appears to be an element of danger. In the mines of La Peronnière, France, a fire was nearly produced by the electric current short-circuiting through the insulation on to the lead envelope, which exploded and speedily caused a good earth with the moist ground. [Illustn. xxviii, figs. 117-121.]

The only preventive for a short circuit is a cut out or a safety fuse, which is described in the Fire Risk Committee's rules as "a piece of easily fusible metal, which would be " melted if the current attains any undue magnitude, and would thus cause the circuit to be " broken."

The Board of Trade regulations state "that this fuse shall be of such a nature as to cut " off the supply of electricity when the current exceeds by fifty per cent. the maximum current " which the service line is intended to supply." It is true that a smaller margin than fifty per cent. may be used, but this is not compulsory, and, I think, should be so. If a copper or lead wire is employed as the safety fuse, a dangerous arc may be formed before a fuse with a fifty per cent. margin is ruptured. Anyhow, the cut out should be so quick in its action that there would be no time to set fire to the inflammable insulation. In order to ascertain which was the most suitable and reliable material, I tried a variety of metals, and found that, if their area was much more than that of a fine wire of four or five millimètres, they all became unreliable. Lead which has been largely used oxidises after a length of time, and gives trouble on account of its expansion and contraction; the alloys of tin and lead, which conduct the same way as would wires made of their component parts, gradually become altered in resistance by the passage of the current. This is noticeable in whatever form the alloy is

used; so that safety fuses which have been tested to melt with 100 ampères, have, after a month's work, gone at 75. [Illustn. xxx, figs. 128-132.]

A great disadvantage attending the use of a fuse of large sectional area is the disruptive effect which takes place at the time of fusion. This is probably caused by the metal first liquefying on the outside, absorbing the latent heat, thus leaving a crust of cooler metal between it and the hot inside; at the moment of rupture this shell bursts with a loud report, and scatters a stream of metal in all directions. I have heard of the top of a connecting box being displaced by the bursting of a bad cut-out in the streets of New York; whether this happened or not, some alarm would be felt if any noise occurred in a house, especially if it was accompanied by a shower of hot metal. [Illustn. xxviii, figs. 114-116.]

The difficulty is overcome by using either rods of fine wire, or better still, by strips of metallic foil, the particles of which do not so readily take a gobular form when melted, and are thus not liable to set on fire an inflammable material.

After experimenting with numerous foils, I obtained a special alloy of aluminium, the resistance of which, as compared with silver, is about 45 per cent. This material, which behaves as one of the three metal alloy class, has very slight increment of resistance when heated, and has the advantage over foils composed of tin or lead, in that its great tenacity enables it to be kept at a very high temperature without becoming plastic.

The use of "safety fuses" appears to be rather a crude remedy, in that the lights are extinguished, but this need not be the case if a simple arrangement of "bye-pass" circuit be employed so that the supply of electricity may be automatically reduced by means of a resistance until the safety fuse is renewed.

Testing an Installation.—To insure this being properly carried out, a current capable of overcoming a high resistance should be sent through the whole of the wires, that from an ordinary battery is of little use. A portable hand apparatus is used for this purpose in America, which, on turning a handle, sends a current through the wires and shows any leakage by ringing a bell. This instrument is capable of sending a current through an exterior resistance of 7,000 ohms. The method of using it is to fasten one terminal to a conductor leading to the earth, and the other to the lighting system. When the resistance of the insulation between the system and the earth is less than 7,000 ohms the bell will ring. The only way to ascertain whether the safety fuses are actually reliable is to short-circuit the wires in different places while the ordinary working current is passing.

The foregoing remarks have been made with reference to incandescent lighting, but apply also to arc lights which may produce other fire risks as well. The chief of these is the danger from pieces of incandescent carbon being dropped, and more fires have occurred from this cause than from any other.

Before leaving this important branch of my subject it may be interesting to note how some of the fires have occurred in America where the electric light has been the cause. In one district of sixty-one miles there were fifteen fires due to some form of "short circuit," generally due to leaking water, or washing floors. All of these would have been prevented by proper insulation and reliable fusible safety plugs. Three fires occurred by cross arcs of one wire to another, where uninsulated wires were fastened against conductors. In one instance the conductor was formed by dust settling upon uninsulated wires, and one damp day it

absorbed enough moisture to form the path for the formation of a cross arc which started a fire. In another instance the wires were fastened to a damp beam which was decayed, and burned nearly in two by a smouldering fire. In a third instance damp brickwork in a tunnel was a sufficient conductor to establish an arc which did not do any material damage there, but injured the dynamo. These fires were not necessarily destructive ones, as they generally occurred during working hours and were soon discovered. Electricity, having no smell like gas to betray a leak, shows when it is escaping by the diminished appearance of the lights, caused by the diversion of the system.

In London, Captain Shaw reports no fire due to electric light for 1882, but one in 1883 due to overheating of the wires. The installations here have, as a rule, been in the hands of skilled persons, and it is most necessary that, in the hurry to push forward the introduction of the new light, the work of wiring houses and fixing the lamps should not be undertaken by bell-hangers and others not having the requisite electric knowledge.

The chief element of safety of electric light is the employment of experienced men to supervise the work of running the wires and arranging the installation; it is then far less dangerous than gas, which not only poisons the air we breathe, but remains as a slumbering volcano ever ready to exercise a terrific power. Hardly a day passes without reading accounts of a gas explosion probably due to a servant's carelessness, or to some cause which would be absolutely impossible with electric lighting. When properly arranged, the latter is far safer than any known illuminant, the entire danger being localized in the generating station, where the steam engine, or motors producing the electricity, would be under constant supervision. It is to be hoped that the Insurance Offices will soon appreciate the safety of the electric light, when installed comformably to their rules, by reducing the premium on the insurance of theatres, public buildings, and houses from which gas is entirely excluded.

Accidents from the Electric Current.—The risk from this cause in reality is very small, and especially so with the continuous currents which would be used for the private supply of a house; also the Board of Trade limit which allows of a difference of potential of 200 volts would seldom be reached. This limit is quite within the margin of safety, although personal experience enables me to state that even momentarily touching two conductors having a difference of potential of 200 volts is not altogether pleasant.

With alternating currents the limit is 100 volts, and the alternations, that is to say reversals of current, are not to be less than six hundred per minute.

Before closing this Paper, a few remarks on the all-important subject of wear and tear, and working cost, may not be inappropriate.

Wear and Tear.—The annual outlay on electric plant is practically very small, with the dynamos it is almost inappreciable, providing there is no break down, and resolves itself into the renewal of the brushes which pick up the currents from the rotary bobbins, and, in some systems the renewal of the commutator. I have recently had occasion to report to the Engineer of the Mersey Dock Board on the electric light installation at the North Docks, Liverpool. The dynamo machines are eight in number, Gramme pattern, and some, which have worked nightly for the dock illumination during the past three years, had been used for three and four years previously for contractors' lighting during the building of the dock. There were no signs of wear, and the electrical test of the oldest machine showed it

was in as good condition as when purchased. Another instance may be cited showing the small amount of depreciation this kind of plant undergoes through wear and tear, namely, that the two Brush dynamos used nightly for the lighting of the South Kensington Museum, one of which has been working three and a half years, and the other four, have only had fifteen shillings each spent on them for repairs, which consisted of new commutator plates.

Cost.—It is difficult to make a comparison between various methods of illumination, because a change of light is always an excuse for more light. The introduction of gas necessitated a more brilliant illumination of streets and houses than was practicable with oil or candles, and in a similar manner the users of electricity always desire more light than they have hitherto enjoyed with gas.

The almost entire absence of heat from the electric lamp enables us to light our rooms to a standard of brilliancy that was hardly possible before, on account of the vitiation of the atmosphere. Naturally this entails extra cost, and is one of the reasons why the electric light appears comparatively much more expensive. Another reason is that the fixed expenses of electric light are much higher than with gas; for instance, let us take the following as a comparative estimate of the charges on 200 Swan lamps, installed, say in a mill, under the most economical conditions as compared with 200—5 foot gas-burners. The first cost of the former would be about £500., if power is provided on which must be allowed per annum—

Interest 5%	£25	0	0
Depreciation 7½%	37	10	0
Repairs to Machines	7	10	0
Total	70	0	0

A meter and gas pipe would cost for 200 lights about £120., upon which interest and depreciation would be £15. per annum.

To bring the cost of the electric light to that of gas, it is necessary to distribute the fixed expenses over a large number of working hours.

If 300 hours per annum are taken, the expenses would be as follow with electric light:—

Coal at 3 lb. per horse-power per hour, at nine shillings per ton, or 6,000 H.P. hours

	= ·014	per hour
Interest, depreciation and repairs	·280	„
Renewal of lamps, etc.	·050	„
	·344d.	„

or about 40% above gas at three shillings per 1,000 cubic feet.

If 3,000 hours per annum are taken, the items will be

Coal	·014
Interest, depreciation and repairs	·028
Renewals	·050
	·092

or less than half those of gas.

By a simular calculation the cost of each illuminant, where both are manufactured on a large scale, will be found to be equal at about 600 hours, when the cost of each will be ·212d. per hour.

Mr. Coope has recently sent to *The Times* an interesting account of the cost of working his electric lighting plant of 200 lights for a year. The total cost per 20 candle lamp per hour comes to something under a farthing (the exact sum being ·95 of a farthing). The total number of hours per annum being 1823. In an ordinary country house the actual number of working hours would probably not exceed eight hours per day, say for half the year, so that the total would not be more than about 1,400 hours per annum at the most, which would materially increase the cost; on the other hand, gas specially made in a country house will probably never cost less than five shillings per 1,000 cubic feet, and in many cases very much more. In America where the cost of gas is considerably in excess of what we pay here, and about what might be termed country house price, the electric light by incandescence is being very widely used as well as the cheaper arc light. The Merrick Thread Company, Holyoke, have the Edison system, using light 2,869 hours per annum. They find the cost of the electric light to compare with gas at 65 cents per 1,000, whereas the city gas works charge $2.00 per 1,000 cubic feet. Also Messrs. Grant, Bros., of Providence, use Maxim lamps in their cotton mill, which they find costs them the equivalent of gas at sixty-six cents per 1,000 cubic feet, instead of $2 per 1,000. These results are favourable as the mills run sometimes at night, also the proportionate cost of power should be added.

I have mentioned these examples, as they both come from reliable sources, and are the result of a longer experience with the electric light than we have had here. That the system adopted in New York is a success may be imagined from the fact that at the present time two new additional establishments for the general supply of electricity in that city are being planned, one to contain 7,000 and the other 9,000 horse-power.

It is not to be supposed that the electric light in a country house can be produced at these prices; even if the cost was higher than that paid for a private gas supply, I should have no hesitation in recommending the extra cost for those rooms where the preservation of works of art, books and decorations, has to be considered. The property of not vitiating or heating the air will be the salient one, which when fully appreciated must banish gas and oil from the houses of those who consider sanitary excellence the principal feature of a beautiful home.

KILLINGWORTH HEDGES

[Remarks by John Slater, B.A.(Lond.), *Fellow*.]

The author of this interesting Paper has alluded to the disappointment which has been rather largely felt at the want of success of the electric light compared with what had been expected of it. It is worth while to try and find out what is the cause of this disappointment, and whether it is well founded. There can be no doubt that three years ago, when I first had the honour of bringing this subject before this Institute, the hopes and expectations of the brilliant future immediately in front of the electric light were at their highest pitch. The practical demonstration of what had been done in this country and in France, the actual achievements of the talented American inventor Mr. Edison, and the confident tone with

which he predicted even greater successes, all combined to excite in the mind of the public a totally exaggerated and unwarranted belief in the immediate commercial success of the supply of electricity for lighting purposes. Now, without for a moment endorsing the celebrated dictum of Carlyle, that this country contains thirty millions of inhabitants, "mostly fools," there is no doubt that ninth-tenths of the people who indulged in those sanguine expectations knew absolutely nothing of the subject, and that the remaining one-tenth knew rather less because they thought they knew a great deal. The consequence was that the views held then had no sure foundation in fact, and they speedily culminated in a most unfortunate mania which did more than anything else to depress electric lighting, for it brought about the two-fold evil of Stock Exchange speculation and immature installations. These things have injured electric lighting woefully. The installations put up by people who knew very little of the practical details of the subject resulted in inevitable failure, which brought discredit upon the new illuminant; and Stock Exchange speculation led to the extraordinary and unprecedented increase in the value of the shares of the first electric light company, which made everyone anxious to get shares in any company, no matter what. This led to the promotion of a number of companies, many of which gave large sums for inventions absolutely worthless, and it finally injured the British public most materially in its most sensitive part—the pocket. Consequently, when many of the various electric lighting companies went straightway into liquidation and those doing good work were unable to pay dividends, the public came to the conclusion that electric lighting was a failure, and clamoured for the winding-up of the companies concerned in it. But I would ask confidently, notwithstanding all the attacks of its enemies and so-called friends—has it been a failure? Pay a visit to the theatres where the light has been installed; ask the numerous hotel-keepers and restaurant proprietors who are using it; inquire of the large steam-ship companies who are sending forth every day new steamers fitted throughout with incandescent lamps; go to the numerous private individuals who, at considerable cost, having to supply plant of their own, are in increasing numbers discarding gas in their houses for illuminating purposes, and then say if you can that electric lighting has been a failure. If ever there was an invention in reference to which the motto "festina lente" should have been adopted it is this; and my own belief is that the present cloud which overhangs the electric light is only temporary, and that the depression and disappointment now existing are as much without foundation as was the extravagant elation of three years ago. There is no doubt at all that difficulties—weighty difficulties—still exist, which will have to be surmounted before we can have the light in our houses with the regularity and simplicity of gas; but these difficulties are gradually being surmounted. If I may use the expression, "the centre of gravity" of these difficulties has shifted. At one time it lay with the dynamo machines. The last time that I showed the light here it was necessary to have a number of resistance coils in order to adjust the current of electricity to the number of lamps burning at one time; but Mr. Hedges tells us of the Edison-Hopkinson and Crompton dynamos which have obviated the necessity for this. At another time the difficulty lay with the lamps; but now it lies rather with the mains for general distribution. These are now made of copper as nearly pure as possible, because this metal is the best conductor of electricity. But copper is an extremely costly article, and if anyone could discover or invent a material of equal conductivity with copper and about one-fourth the price, the problem of the general distri-

bution of electricity for lighting purposes would be vastly simplified. I should have been very glad if Mr. Hedges had given us his views as to two great practical difficulties which lie in the way of domestic electric lighting—viz., the wiring of houses and the fittings for the lamps. If you are building a new house you can easily arrange for chases in the walls or ceilings where the wires are to go, and you may even make them conducive to ornamentation by covering them with raised plaster mouldings, because you cannot have a better insulator than plaster or cement. Of course it would be a splendid thing, for architects, if everybody who wanted the electric light would build a new house wherein to have it; but we cannot expect that, and if we have to introduce it into an existing house we must adopt other measures. If you begin cutting away for chases in the walls or ceilings you damage all the interior decorations and lead to no end of expense. It would be astonishing to anyone who has not seen the cost to know how large a proportion of the expense of installing the electric light in an old house is caused by cutting away and making good, and this is an item which is very likely to be under-estimated beforehand; so that it would often happen that a client would be very much disappointed, after an estimate were framed, at finding the expense so much heavier than he was led to suppose. The best plan therefore is, not to attempt to conceal the wires behind the plaster, but to have them covered with a good insulating material corresponding in colour to the decoration of the room, and then plant your wires, which are very small, under a projecting moulding of a dado or cornice. You would be astonished to find how little visible the wires are in such a position. In regard to fittings, it may possibly be remembered that, two years ago, I expressed myself strongly in favour of doing away with fittings to a large extent or altogether; and I am very pleased to say that experience has only confirmed me in that view. I shall not go into any detail upon that point, because I hope that Mr. Crompton may give you the result of his wide experience. I would only say that single lamps suspended from the ceiling by thin cords have a good effect in a room. Some modern makers of electroliers produce tasteful and artistic fittings, but they are very expensive; or, if cheap, as a rule they are very nasty, and at any rate they lead to much additional cost in any installation. There is one point where a caution is wanted—viz., I do not think it is wise to endeavour for economy's sake to utilise the existing gas-fittings for electric lamps. They look incongruous, and moreover electric wires, if they pass through gas pipes, seem to deteriorate very rapidly, and may lead to dangerous accidents. The best plan is, if you want to avoid undue expenditure, to do away with the thing altogether. The question of cost is very important. In a country house, I think there is little doubt that if you have a large building that you want to supply with lamps, you can put up an electric light plant which will cost very little more than gas; but if you have to put a gas or steam motor in the cellar of a London house, it must cost more. No one can yet tell what is the minimum price per unit of electricity which can be profitably adopted by the lighting companies when they begin lighting from a central station, because no central station has yet got into operation. The probability is even then that the cost charged will be more than that of gas, but there will be a very great saving in less deterioration of furniture and decoration, and in the increased vitality of the persons using the rooms; and as the number of consumers increases the price will fall. Electric lighting is no poet's dream. It is a practical, accomplished fact, and for its permanent success to be assured and to be speedy only two or three things are wanted:

in the first place, the greatest possible care and attention to all details on the part of everyone who has to do with the supply of the light, whether the engineer who furnishes the motor, the electrician who supplies the dynamo machine and the lamp, or the architect who has to arrange for their decorative application; and combined with all this we must ask from the public a little patience and forbearance.

JOHN SLATER.

[Remarks by Mr. R. E. Crompton.]

Electric lighting is, for the moment, under a cloud; but we who are the actual workers know that there has been no retrogression or even pause in its progress. As far as electric lighting itself is concerned, it has gone forward steadily, and quite as quickly as was desirable or possible. Such a new science requires a great many new minds to work it out, and to develop it in such a form that it may be of practical use; and that development has, I think, been as rapid as the most hopeful of us could expect. When I tell you that dynamo machines of a given size have been made to give a commercial output two-and-a-half times greater than they did two years ago; when I tell you that the lamps have been improved so that they last twice as long; when I tell you that the cost of almost every part of the apparatus used has been proportionately decreased; that the greatest of all reproaches to electric light—its element of uncertainty—has been so much removed, that there are many large installations at work that have never yet suffered the least derangement or hitch of any kind, although many of them have several hundreds of lamps burning nightly; when I say that advances such as these have been made, it can scarcely be justly said that electric lighting has been standing still. The disclosures which have come to light at the public meetings of various electric lighting companies have shown conclusively that the complicated executive staff of a limited liability company is ill-suited to cope with the difficulties of such a progressive manufacture as this is, and that we must look to the competition amongst private firms for any great advances in development. Mr. Hedges holds out great hopes that we shall obtain great economic results from the use of Dowson's gas with gas engines. From all I can hear it is a wonderful invention. Theoretically the gas engine is a more economical heat engine than the steam engine is. I have successfully used a great many gas engines made by Messrs. Crossley, but the great bar to their more extended use is their high first cost; also the cost of working when ordinary London gas is used is far higher than that of a modern economical steam engine. If by the use of Dowson's gas this disparity is removed or even lessened, it will greatly forward the introduction of the electric light. The author has been pleased to speak in a kindly way of the invention of Mr. Kapp and myself of the compound dynamo machine which, as he says, greatly increases the convenient use of the electric light for domestic purposes, as the user can turn as many lights off and on as he pleases without having the complication of adding resistances; the regulation of the light at the standard brightness being automatically performed by the dynamo itself. A good deal of the unsteadiness of the lights used to be due to this want of regulation of the dynamos: whenever lights were turned off or on, the remaining lights gave a jump or flicker. All of this is now avoided. As Mr. Hedges has said, the current supplied by the old non-compound type of dynamo was of the nature of a gas supply not regulated by a governor. I cannot speak highly enough of Mr. Hedges' labours in regard to safety fuses or

fusible foils. Mr. Hedges has addressed himself in the most unwearying manner to a series of experiments on this subject. These have resulted in the present fusible foils, which I can speak of (having used them in the Royal Courts of Justice) as being successful. When using these safety fuses for places of public assembly, we must be very careful not to go too far in protecting the mains from over-heating, because if we use narrow margins very slight heating would cause the fusible foil to act and so plunge the building in darkness. We might thereby cause such panics in the building as would be far more dangerous to human life than the over-heating of the wire. I myself personally disapprove of large fusible cut-outs on the mains or branch mains themselves. If we protect each and all of the small lights by a small fusible cut-out, it is quite sufficient. It is, however, probable that the large ones will very rarely come into action. Mr. Slater has mentioned the cost and difficulty of fitting the electric light into old houses, and has also mentioned one way out of the difficulty. I may add that another plan my firm has hit upon is to take possession of the tribe of bell-hangers and teach them to be electric light wire men. We have found the ordinary bell-hanger a handy fellow about an old house. He generally knows the run of the floors and how to get through the walls, and how to make small holes through the ceilings and walls without knocking the plaster down. We engaged a number of these men, and they soon learned the electrical part of the work, and this has greatly reduced the cost of wiring a house. The plan we have adopted (and I learned it from Mr. Slater) for lighting rooms is in most cases to light from the ceiling. We take up the floor of the room above, thread the wires through the joists at safe distances apart, and pierce the ceilings with properly constructed tools. In this way we can wire a new or old house with almost equal facility, and at a minimum of expense. In addition to the safeguard given by fusible safety foils, the danger of over-heating of the conducting wires is best avoided by insisting on their being of ample section to carry the current. If, by cutting prices, the use of wires of small section is encouraged, I feel certain that dangerous over-heating will result. I may say that, although I have had to do with the fixing and wiring of from 70,000 to 80,000 incandescent and arc lights, I have never had an accident from over-heated wires; and, in fact, have never heard of one being over-heated; and I believe that the reason of that has been that we have never yet condescended to cut down the size of our wires. In these days of competition this cannot go on for ever. Before long there are sure to be a great many Richmonds in the field, and every man round the corner will say that he is able to run electric wires cheaper than the large firms. The result will be—I look forward to it with dread—fires and troubles, and lights going out, and electric lighting getting a bad name. I look to you, gentlemen, for aid in this matter. Whenever you have to specify the electric light, see that your specifications are stringent on the question of gauge and insulation of the wires; and that the wiring when completed is inspected and tested by competent electricians. I have already occupied your time far too long. One gentleman asked a question upon the position of cables. It is nearly always a matter of convenience. The large perpendicular chase which is usually left in most modern houses for the service pipes is far the best and cheapest position in which to carry the vertical conductors; from this we usually branch off the horizontal wires underneath the floors, and drop the lights from them into the various rooms. Mr. Hedges said that he found that 200 volts of electro-motive force was as much as an ordinary person could bear

without inconvenience. I must remark that this question depends very much on individuals. Those persons who have habitually a moist skin feel 200 volts, whereas those with dry skins cannot feel 300. I myself have had 600 volts through my chest and arms with no ill effects, but a burning sensation and a scorching effect on the skin where I touched the wires. The chief danger of the electric light—and too much stress has in this Paper been laid upon its danger—is from cheap material and bad workmanship. With a small modicum of care and a proper sum allowed for putting the wires into position the danger is infinitesimal, compared with that of gas. Our great rivals, the gas people, dwell much on this bugbear of danger, and talk of the high tension of the electric light, as if people were knocked down right and left by it. But in spite of the fact that in America the use of the most dangerous class of current—*i.e.* that used for series' arc lighting—is very common indeed (many hundreds of mills and other buildings used for industrial purposes being lighted by it), the number of accidents which have happened is extremely small, not more than five or six people having been killed during the five or six years that the electric light has been used; and they have met their fate by the high tension of the arc current. Where incandescent lighting has been employed, I am not aware of a single accident having happened.

R. E. CROMPTON.

VIII. PRECAUTIONS TO ADOPT ON INTRODUCING THE ELECTRIC LIGHT INTO HOUSES. (xxviii.)

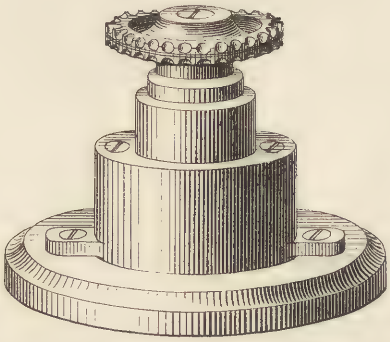

FIG. 112. SWITCH FOR BRANCH WIRES.

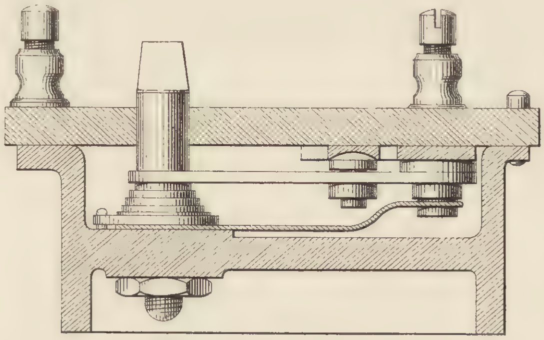

FIG. 113. SWITCH FOR MAIN.

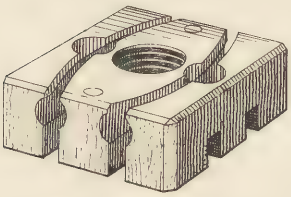

FIG. 114. SMALL CUT-OUT.

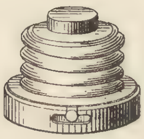

FIG. 115. SPARE LEAD FUSE.

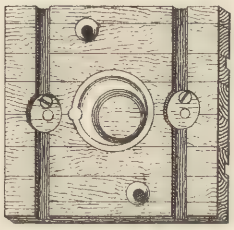

FIG. 116. BOTTOM OF CUT-OUT.

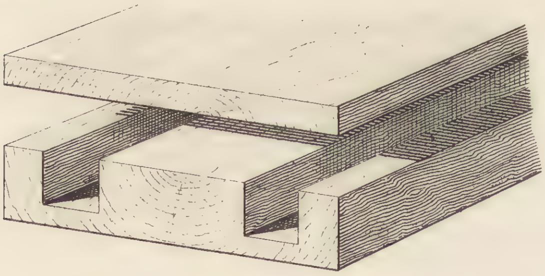

FIG. 117.

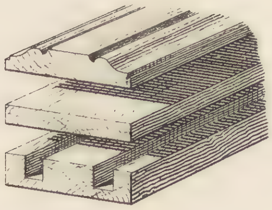

FIG. 119.

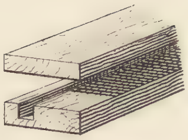

FIG. 118.

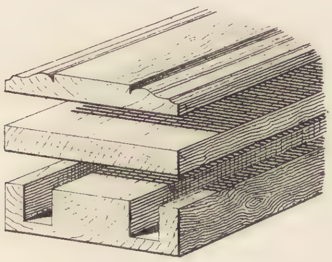

FIG. 120.

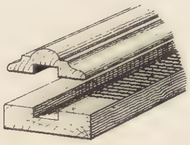

FIG. 121.

FIGS. 117, 118, GROOVED WOOD FOR HOLDING WIRES.
FIGS. 119-121, BEADED WOOD FOR SAME.

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VIII. PRECAUTIONS TO ADOPT ON INTRODUCING THE ELECTRIC LIGHT INTO HOUSES. (XXIX).

FIG. 122.
CABLE WITHOUT INSULATION.

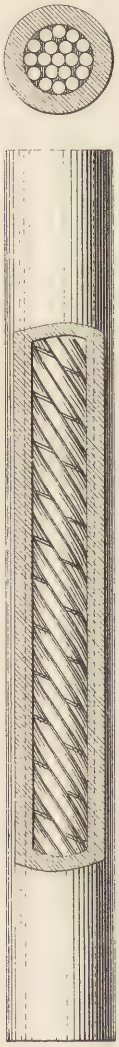


FIG. 123.
CABLE WITH INSULATION.

FIG. 125.
SECTION OF JOINT.

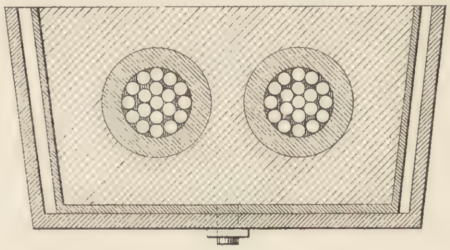


FIG. 126.
PLAN OF CABLEBOXES SHOWING JOINT

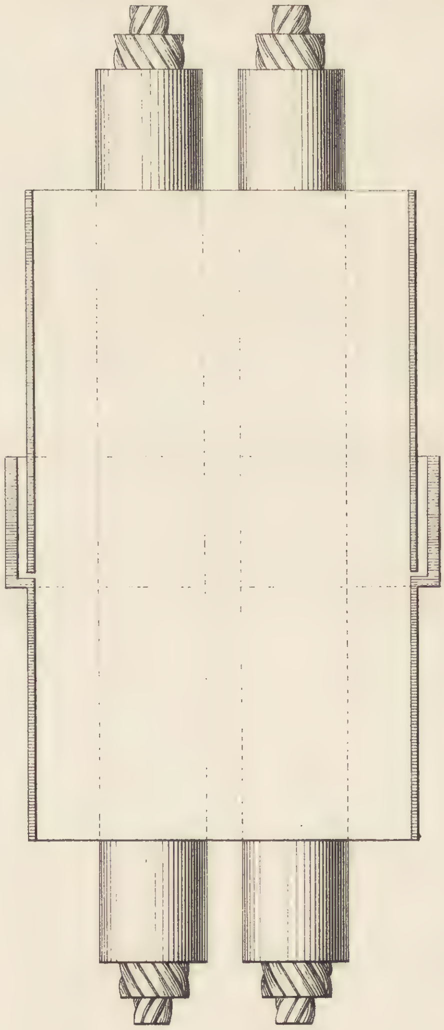
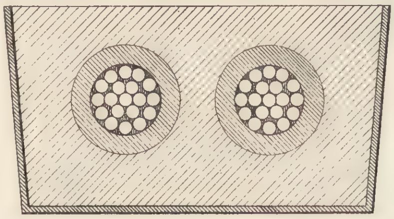


FIG. 124.
END VIEW OF CABLES EMBEDDED IN BITUMEN, READY FOR LAYING IN ROAD.



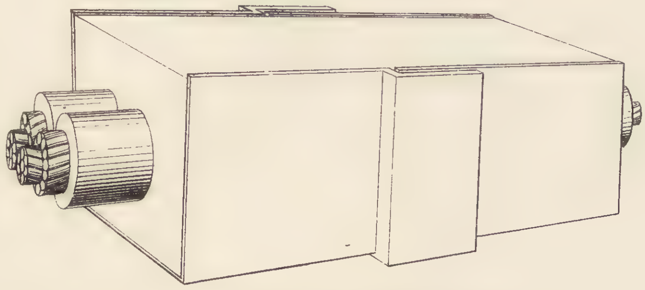


FIG. 127. CABLE AS LAID.

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VIII. PRECAUTIONS TO ADOPT ON INTRODUCING THE ELECTRIC LIGHT INTO HOUSES. (XXX)

FIG. 130. SPARE MICA FOIL OR FUSE.

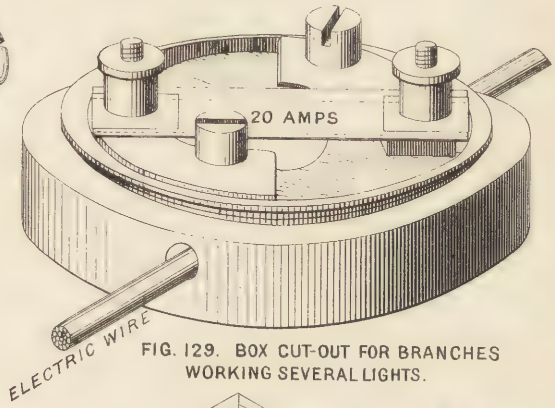

FIG. 129. BOX CUT-OUT FOR BRANCHES WORKING SEVERAL LIGHTS.

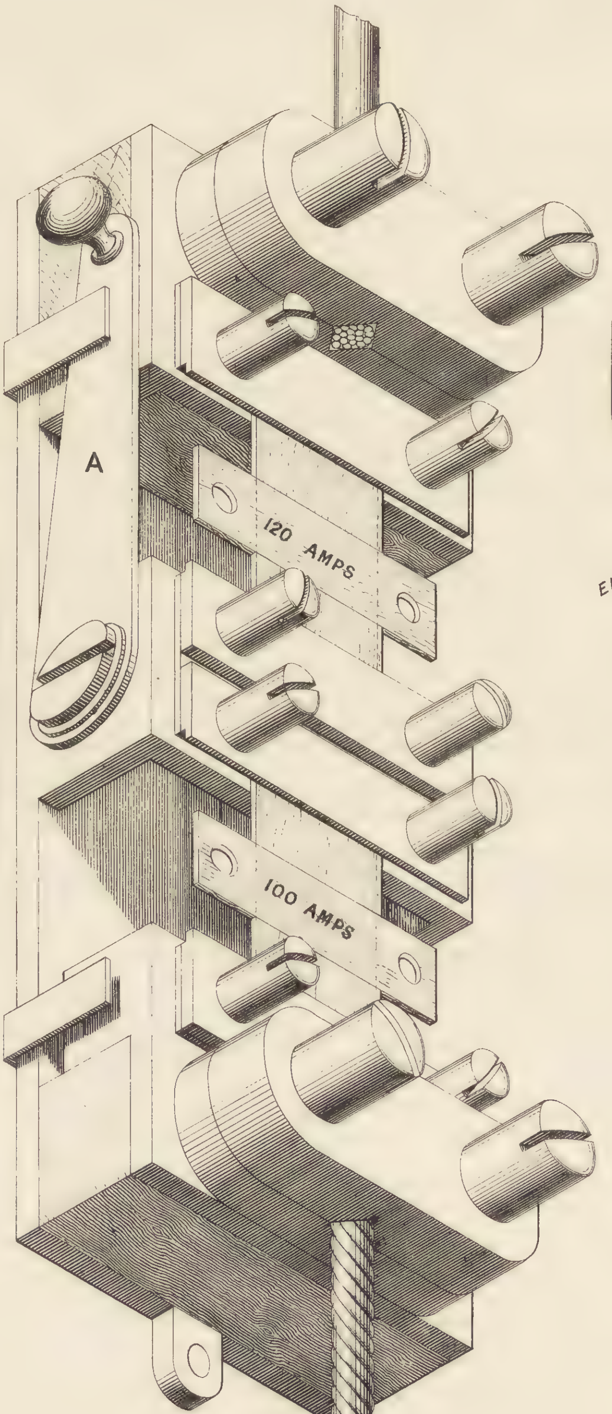

FIG. 128. DUPLEX CUT-OUT FOR MAINS.
A SPARE FUSE OF HIGHER MELTING POWER CAN BE SUBSTITUTED FOR ONE RUPTURED BY TURNING THE HANDLE **A**.

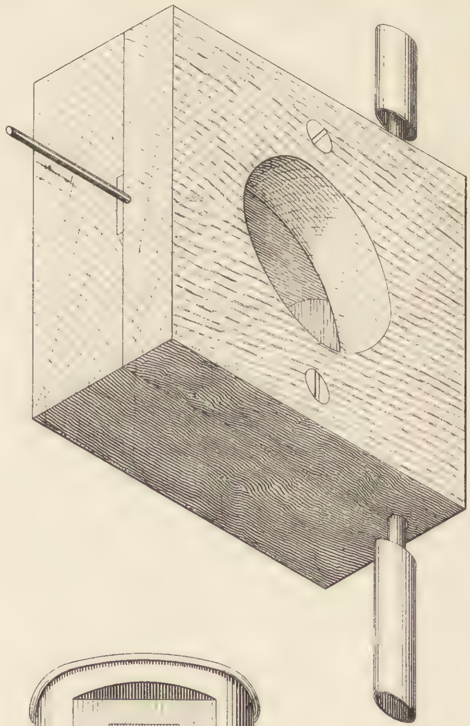

FIG. 131. CONNECTOR CUT-OUT, TO UNITE MAIN TO SMALL BRANCH WITHOUT CUTTING THE MAIN CABLE.

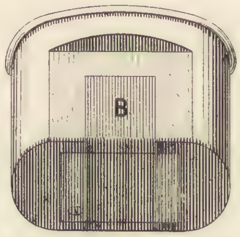

FIG. 132. FUSE WITH WOODEN PLUG.
B IS THE FOIL HELD IN PLACE BY A STRIP OF MICA.

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IX. A DESCRIPTION OF SOME BUILDINGS RECENTLY ERECTED IN INDIA, WITH SOME REMARKS ON DOMES AND THE MINGLING OF STYLES OF ARCHITECTURE. By William Emerson, *Fellow*.

[Read on Monday, 19th May 1884, Ewan Christian, *President*, in the Chair.]

THERE are various points to be considered in arranging buildings suitable to the purposes for which they are wanted in India, with which architects in England are not brought into contact, and which involve such differences in construction that it is a delightful experience to leave the old highways of English architectural thought and work for a while in India. These points are chiefly the climate with its intense heat and its total rainfall occurring almost without intercession in a few months; the habits of the Oriental, which make it difficult for him to work except in the accustomed grooves of his ancestors; the innovation of modern Western thought, and I may as well add, science and culture so opposed to all the antecedents of the conservative Hindoo and his caste prejudices.

With regard to climate: in Bombay the average heat is somewhere about 80 to 90 degrees, Fahrenheit, in the shade during the greater part of the year. In Allahabad it is from 85 to 98 degrees in the shade; at Nassick, in tents under mangoe trees, I have experienced 120 degrees of heat. During most of the year the west wind is the chief available cooling power, and it is utilized by hanging kuscus mats in all openings and keeping them well moistened with water. The wind passing through these mats reduces the temperature considerably. Kuscus is a kind of grass. Thermantidotes are also used. Near these mats or the thermantidotes the air is so cool that it is very conducive to rheumatism.

In the science schools in connection with the Muir College I have suggested a means of ventilating by fans, turned by water, supplied from tanks in a tower and an exhaust shaft with steam coil at top to induce a strong up current. But this is an innovation I doubt the authorities carrying out. The idea one has before living in India is that thick walls and small openings are what is wanted, and on this principle Mr. Burges designed his School of Art for Bombay, which was not executed by the government. To utilize the sea breezes by means of large openings is the chief concern, and then to have thick walls well shaded from the sun, and lastly to have high rooms.

St. Peter's is a good example of the value of thick walls in respect to temperature. During summer it is always cool; in winter it is so warm that the difference in comparison with nearly all the other deathly cold churches in Rome is most marked. There is no artificial heating, and I consider it to be the natural result of the massiveness of the structure.

For these reasons verandahs are a necessity, and the verandah walls are again frequently shaded by overhanging eaves. This arrangement gives a character to Indian buildings quite unlike our western ones, and affords the architect scope for picturesque dealing with light and shade unattainable in England. Verandahs are necessary and where any number of persons

has to congregate, as in colleges or hospitals, they should be all round the rooms and answer the purpose of passages. I suppose this was the *raison d'être* of the old Roman villa plan, as well as of the Hindoo palace, and I find a great similarity between the two. At Beejapore I noticed one or two old houses with a court surrounded by verandahs and rooms, with a fountain in the centre, very like the *atrium, cavœdium* and *impluvium* arrangement of the Romans. The typical plan given by M. Viollet-le-Duc in his *Habitations of Man* also shows this similarity.

High rooms are requisite to obtain lofty and large windows, first for air, because in hot weather the larger the surface of wet mat exposed the cooler the rooms are; and next for light, because the verandahs cast the rooms into deep shade, and though the reflected light is so strong as to throw a shadow upwards, so much light is blocked out by the Venetian blinds and the kuscus mats that the rooms are never too bright, and in the heavy rains these verandahs are often shut in with closed "venetians." Of course in a country where moving even is an exertion, and where ground is comparatively cheap, one-storeyed buildings are preferred. But this hardly applies to towns like Calcutta, Bombay and Madras, where buildings are increasing in altitude each year.

With regard to sanitary arrangements the happy Hindoo is for the most part in the felicitous position mentioned by *Punch:* his drains do not get out of order—because he has none. A bath room in the verandah with commode or earth closet is the usual arrangement; with a separate staircase or approach for the sweeper, whose duty it is to clean these places, and whose proximity or touch would be terrible defilement to the higher castes.

The foregoing remarks explain the seemingly wasteful space occupied by verandahs in buildings like these I am describing, which, being either for worship, study, or nursing, must be cool and well ventilated. The punkahs are usually pulled from the verandahs. Also it will be understood why the plans are arranged north and south, why such lofty rooms, and why separate stairs to lavatories, &c.

With regard to the habits of the Oriental workman, an English architect has much to put up with, much to overcome, and must possess unlimited patience, for, if he makes himself hot with anger and annoyance, he will probably die of heat apoplexy. In the first place they are unaccustomed to our western methods of building, and do not understand drawings; in one building I had frequently to mark out the stones for the masons to work. But there are some splendid masons in India, those of Kattiawar are amongst the best in the world. Natives under the guidance of a "maistre" or foreman will work out the masonry for one of their own temples from foundations to finial without a single drawing of any description. The head man carries it all in his mind; it has been handed down to him from father to son by his ancestors, in the same manner that the Persians manufacture their carpets and shawls, for which cartoons I understand do not exist.

The native is a great scamp as regards his work; to save the trouble of squaring the bed of a stone, even for a column, he will, without the smallest compunction, work it level all round to make a neat joint, and then hollow it out roughly in the centre. I once caught a man carrying up six or eight courses of bricks on either face of a thick wall, which had to carry weight, and then filling up the centre with bats, broken stones and rubbish, and covering it up with mortar. I drew the attention of the native clerk of works to it, who assured me

it had never occurred before, and was an absolute impossibility for it to happen again. But knowing the habits of the wily Hindoo I returned in a short time, and, screening myself behind some timber, saw the same thing going on, and the clerk of works sitting on his heels calmly smoking and watching the process. One therefore expects naturally to find such trifles as hollows in beds of stone that should be level. A favourite method of facing walls in Bombay is with wedge-shaped masonry, and with difficulty a bed of only two or three inches is obtained; if left to himself the native would make it half-an-inch. The scaffolding used is bamboo; and the only timber available, teak; therefore a tower is built up from the inside, and very heavy centering at a great height is a considerable expense. The Hindoo is incapable of following the rush of modern science introduced by the English, and will work only in his own way.

For all these reasons one has in designing work for India to make it stronger than needed, and to allow for a considerable percentage of defective workmanship, and however amusing it may be to reflect here on the odd ways of the Hindoo in his native country, the poor architect suffers one continual round of annoyance and trouble, and though he gains experience, turns after a while with heart-felt pleasure to work in England.

The Muir College, at Allahabad, and the Takhtsingji Hospital at Bhownuggur, will, I think, show the kind of arrangement necessitated by the circumstances I have mentioned. The ground plan of Muir College [Illustn. xxxvii.] forms at present half a quadrangle, and the buildings comprise a convocation hall, library, lecture rooms, professor's rooms, science school and the Vizianagram bell tower. The future additions, completing the plan will, I believe, supply a museum and observatory, and some more lecture and professor's rooms. Here the corridors are on both sides of the rooms. The bath rooms and the latrine arrangements are shown, and the science school with laboratories is placed at the point likely to be least objectionable to the other departments.

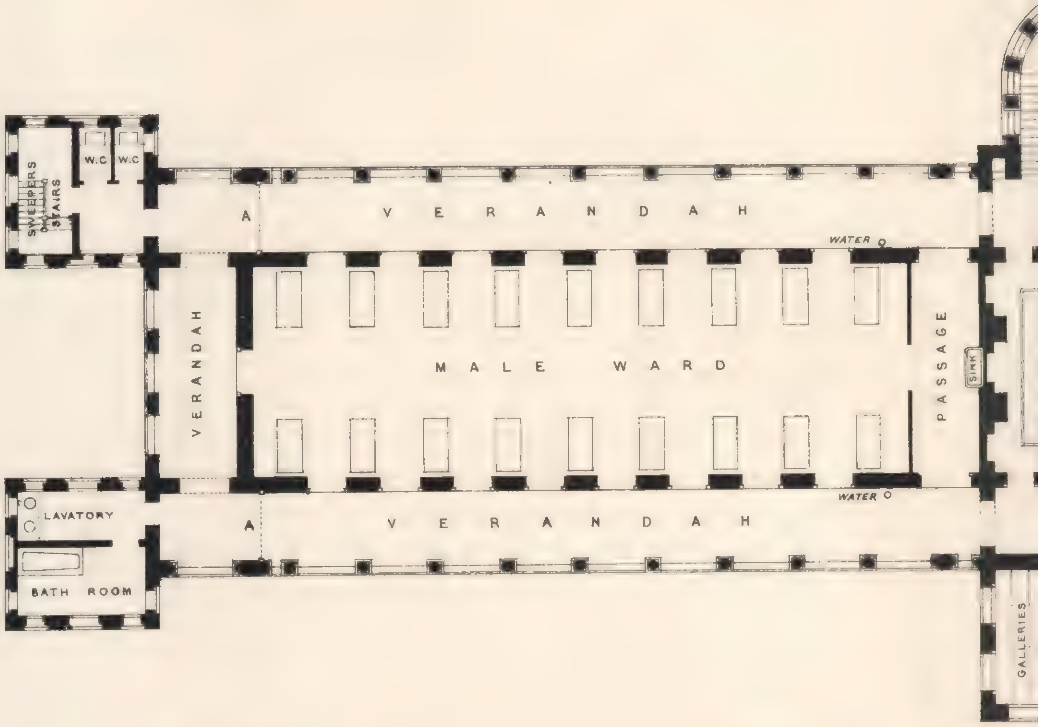
The plans of the Takhtsingji Hospital [Illustn. xxxi.,] speak for themselves with their double corridors, central hall, dispensary and ward arrangements. The staircase is shown fully in Illustn. xxxiv. The passages at the ends of the wards with sinks answer the purpose of the sculleries in our hospitals. The bath rooms and W.C.'s are separated from the wards by verandahs, which can be shut in in wet weather by movable "venetians." Of course every opening from verandahs to wards is a window-door and fitted with glass and blinds. The *bobbache kana* or kitchen is on the ground floor, separated from the main building, and approached by the covered passage shown in Illustns. xxxiv., xxxv.; this arrangement is partly owing to caste prejudices and partly to prevent any unnecessary increase of heat. The general construction of both the Muir College and the Takhtsingji Hospital is similar. The College is of brick faced with a hard limestone from Sheorajpore, in fact, a white marble; the stone is so inexpensive that the extra cost of working it made it about equal to some other softer stones obtainable. The Hospital is brick faced with a good red sandstone, but portions of it, namely, the balusters, some of the columns and the domes, are of concrete made in London, matching the sandstone in colour, and sent out to India by Mr. Lascelles. The floors of both buildings are of iron girders and brick construction; the roofs of the Muir College are of iron-work and brick arches covered with chunam, a mortar made from Kunkur lime. Both buildings are well raised above the ground. The Hospital roof is of teak covered with

tiles—the white ant not infesting that district—and ceiled at the tie-beam, forming a good ventilating chamber over the wards and keeping the hospital cooler. The mortuary [Illustn. xxxvi.], placed at the entrance-gates of the compound, is a square building with openings filled with perforated stone and covered with a dome.

With regard to the style of architecture practised by the English in India, Mr. Chisholm, in his very interesting Paper of last year, says :—"An Englishman may elect to practise in either " of the native styles of architecture, or if he prefers it in a western style, suiting it to the altered " requirements," and he then winds up with the conclusion, "an architect practising in India " should unhesitatingly elect to practise in the native styles." With some modification I think so too. The idea I have had in later years (though I cannot say it was so when I first went to India) is that buildings erected under the British Raj for any purpose connected with the natives, whether for administrative education, or charity, should show a distinctive British character, at the same time adopting the details and feeling of the native architecture, and suiting it to the particular requirements of the case—in fact, following the principle of the Mohammedans, who seized upon the art indigenous to the countries conquered, adapting it to suit their own ideas and needs. This perhaps may be objected to by some as creating a hybrid architecture, but has not the mingling of Mohammedan and Hindoo art resulted in some of the most enchanting buildings in the world, exemplified at Beejapore and in the North-West Provinces? And are not some of the buildings in Europe of mingled styles and feeling as noble works as there are in existence, such as Sta. Sophia at Constantinople; the Cathedral of Monreale at Palermo; the San Miniato at Florence; the interior of St. Mark's at Venice; St. Front at Perigeux; the apse of our own Canterbury Cathedral, and numbers of others? Indeed are not many of the most lovely flowers and plants hybrids, and has not the intermingling of the different families of the human race produced some of the noblest types of men? This is my apology for the architecture of the Muir College and the Takhtsingji Hospital, which I feel must be described as hybrid, though I think not an unpleasing mixture; this however may be prejudice on my part, but it carries out the idea of showing the influence of the British Raj on modern Indian buildings.

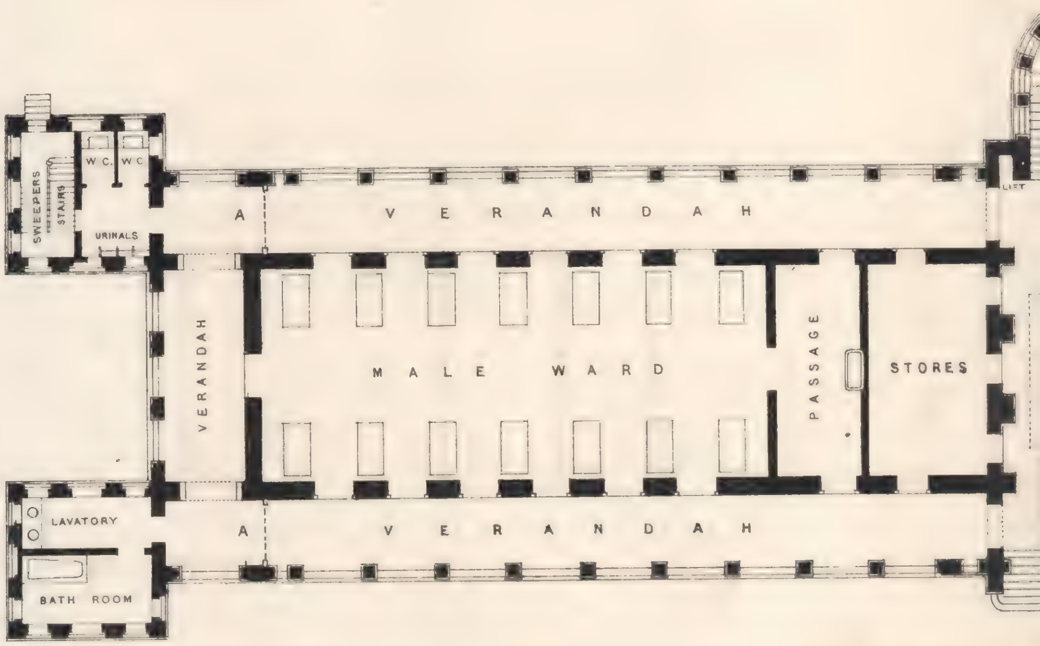
In the Muir College, which is a building for the education of Mohammedans, I found a large bell tower was wanted [Illustn. xxxviii.], to which the Rajah of Vizianagram, a generous and enlightened prince, was willing to give some £10,000. But in India there are only two or three examples of large minars or towers, and quite unsuited to a modern building. So I determined not to follow too closely Indian art, but to avail myself of an Egyptian phase of Moslem architecture, and work it up with the Indian Saracenic style of Beejapore and the north-west, combining the whole in a western Gothic design. The beautiful lines of the Taj Mahal influenced me in my dome over the hall, and the Indian four-centred arch suggested itself as convenient for my purpose, as working in well with the general Gothic feeling. The details show how the Gothic tracery is blended with the Indian geometrical perforated stonework in the windows, and the Caireen Moucharabyeh wood-work; Gothic shafts and caps are united with Indian arches; and the domes stand on Gothicized Mohammedan pendentives and semi-circular arches; the open staircase is also a Gothic feature adapted to Oriental requirements. The pavement of the hall is a combination of marble and stone inlays, mosaic-work and *opus alexandrinum*; the centre represents the heavenly bodies and the four

IX. A DESCRIPTION OF SOME BUILDINGS RECENTLY ERECTED IN INDIA. (xxxi)



AT A THE VERANDAHS CAN BE DIVIDED WHEN NECESSARY.

FIG. 134. — UPPER

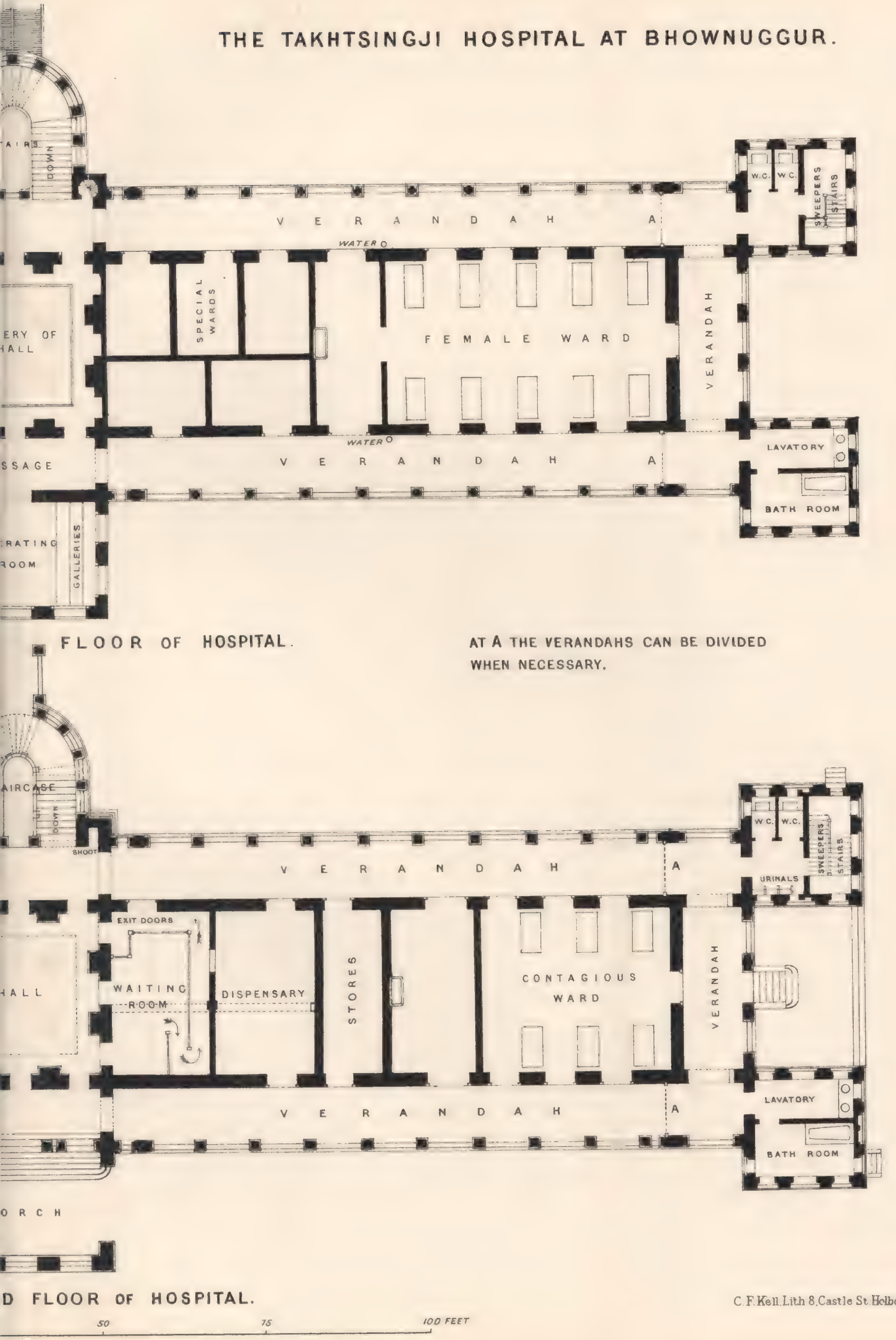


W. Emerson del

FIG. 133. — GRO

SCALE OF 25 20 15 10 5 0 25

THE TAKHTSINGJI HOSPITAL AT BHOWNUGGUR.



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IX. A DESCRIPTION OF SOME BUILDINGS RECENTLY ERECTED IN INDIA (xxxii)

THE TAKHTSINGJI HOSPITAL, BHOWNUGGUR.

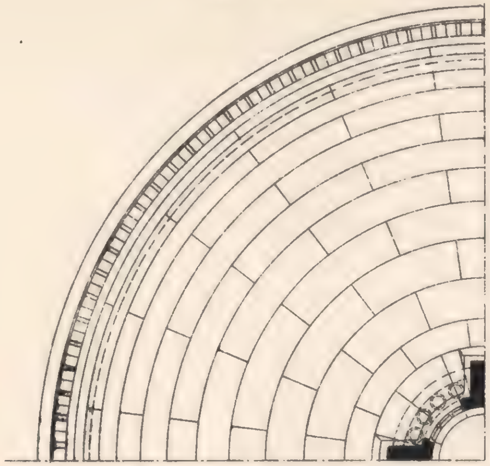


FIG. 136. QUARTER PLAN OF DOME

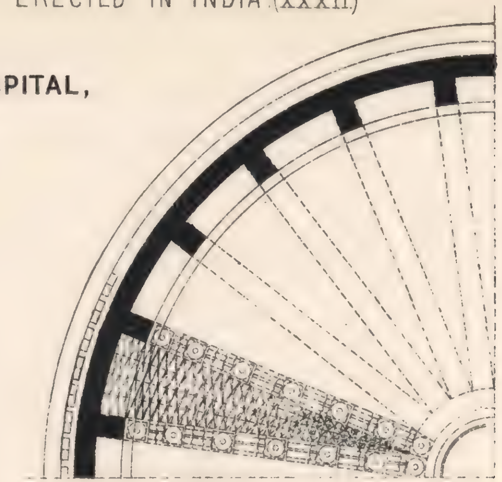
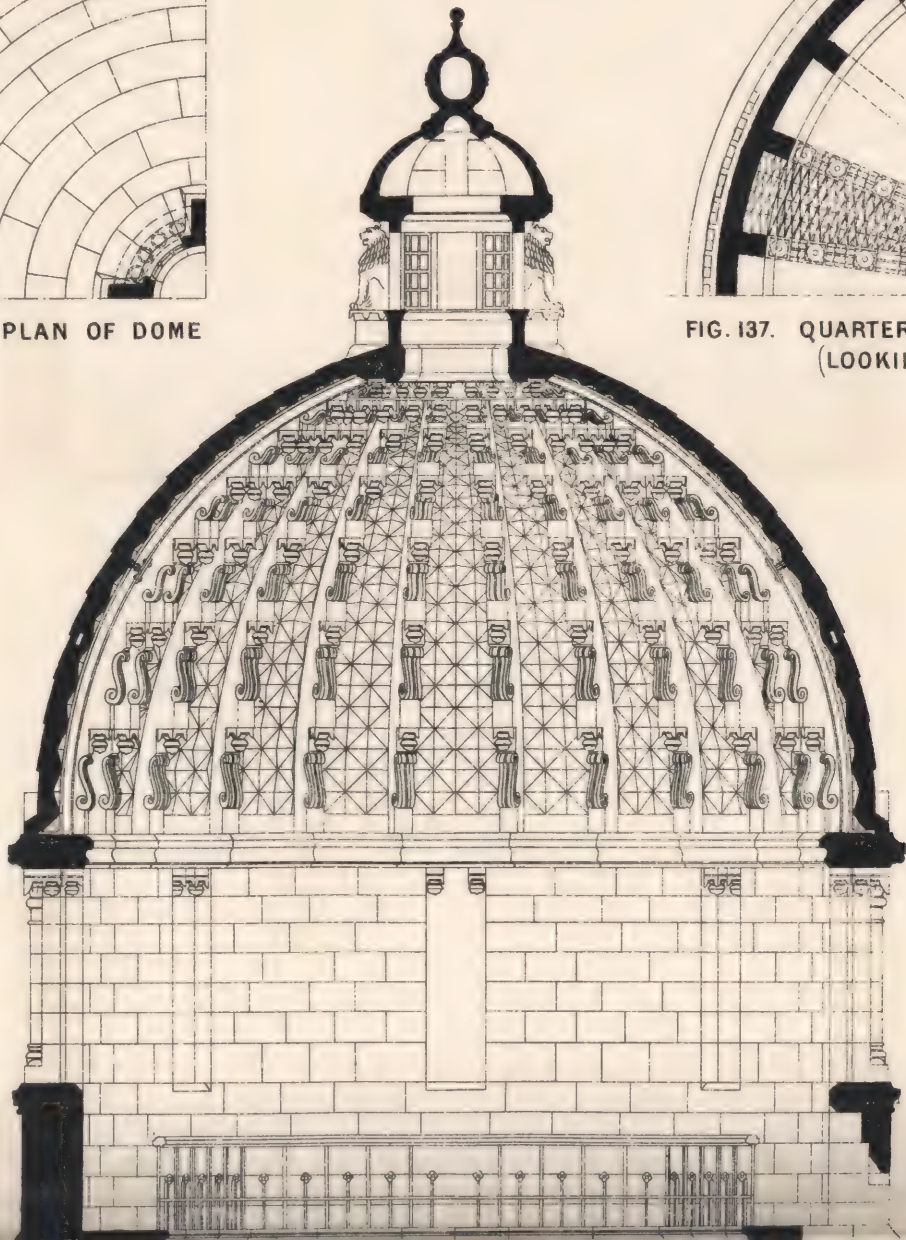


FIG. 137. QUARTER PLAN OF DOME (LOOKING UP)



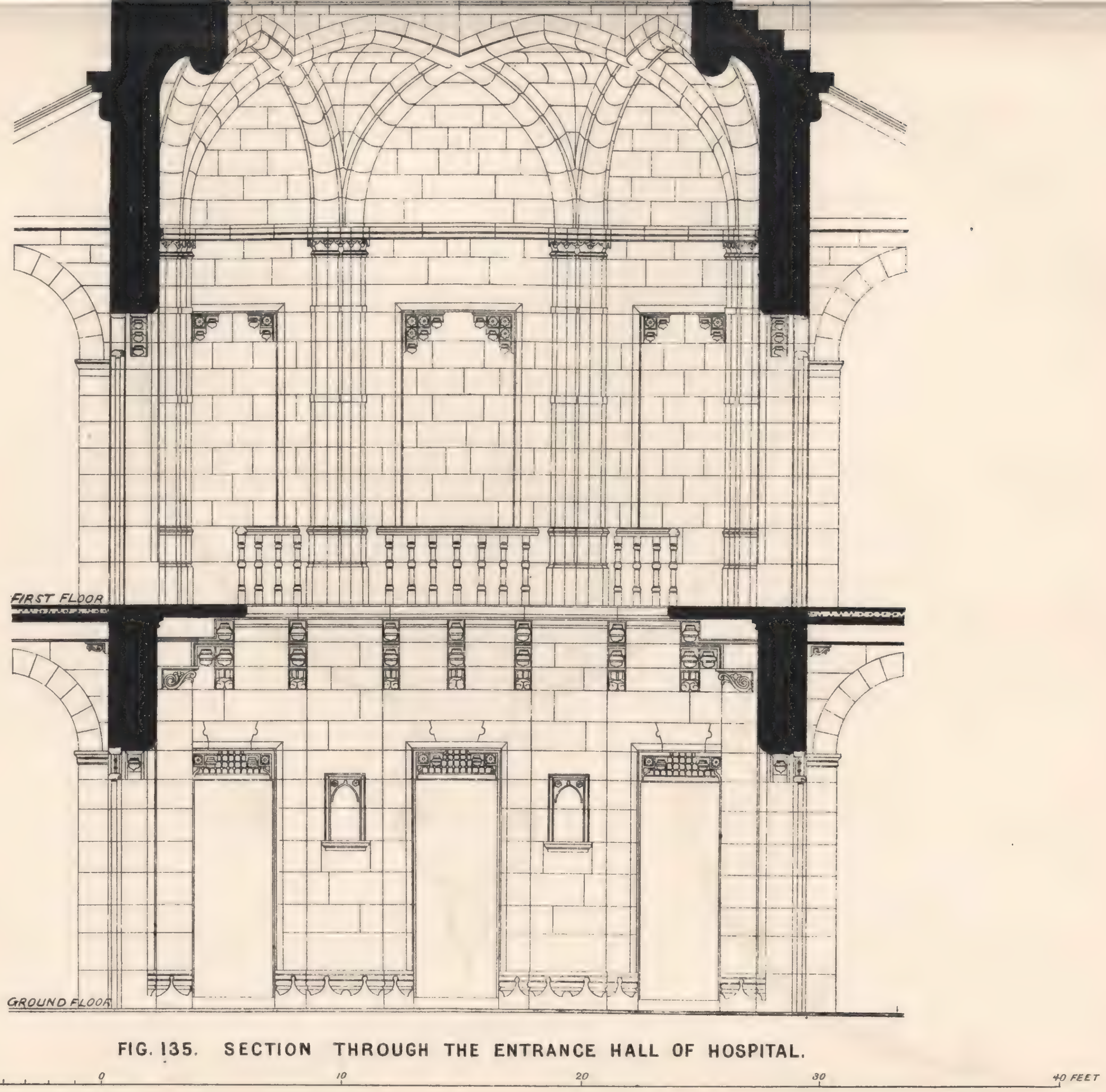


FIG. 135. SECTION THROUGH THE ENTRANCE HALL OF HOSPITAL.

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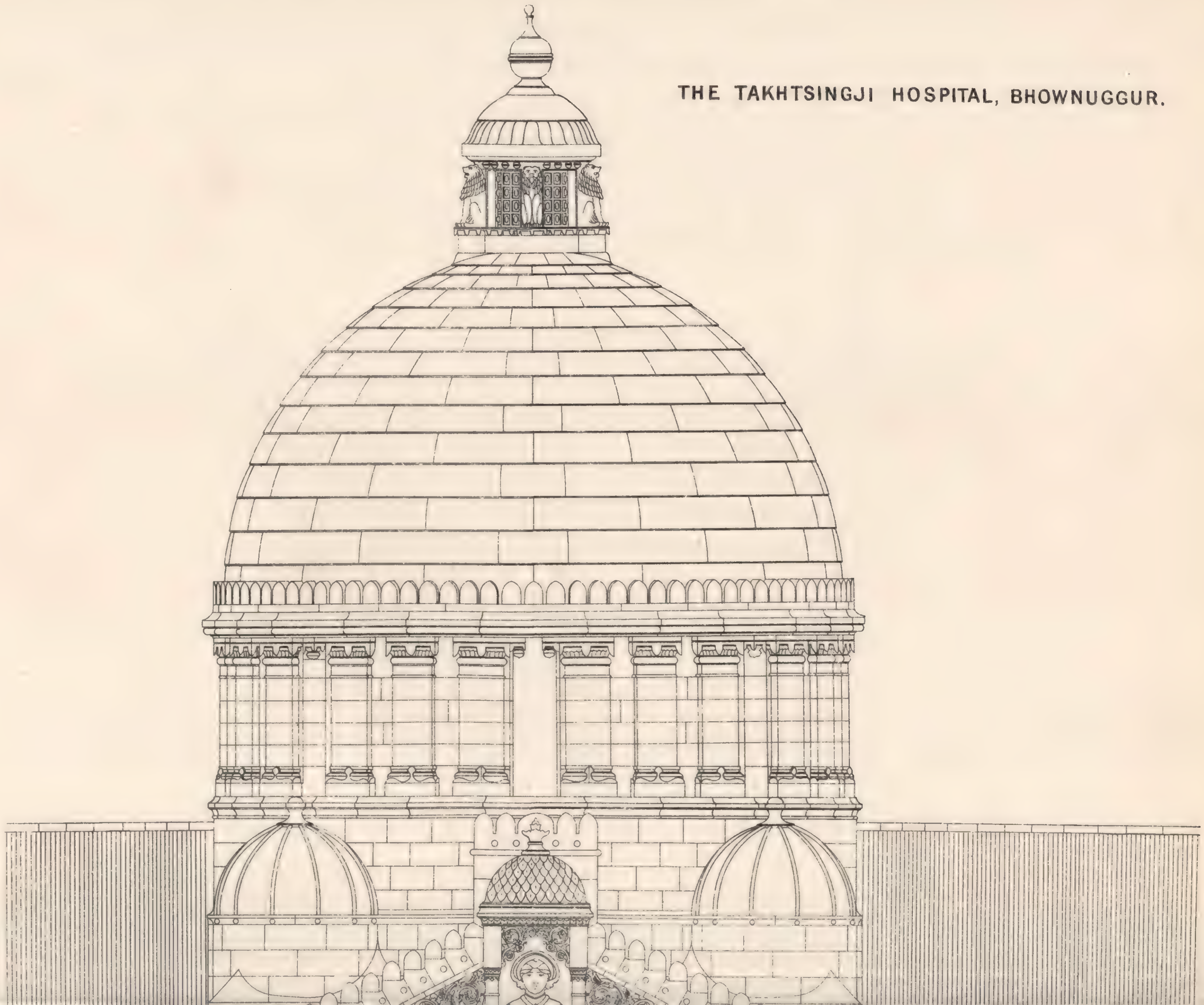
C.F. Kell. Photo-Litho. Castle St Holborn, London, E.C.

THE TAKHTSINGJI HOSPITAL, BHOWNUGGUR.



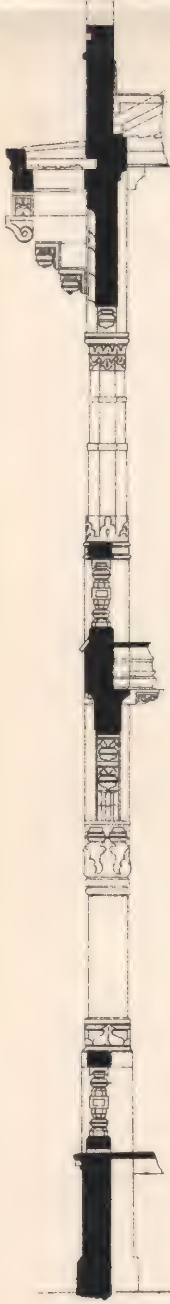


FIG. 139.
SECTION THROUGH EXTERNAL WALL.

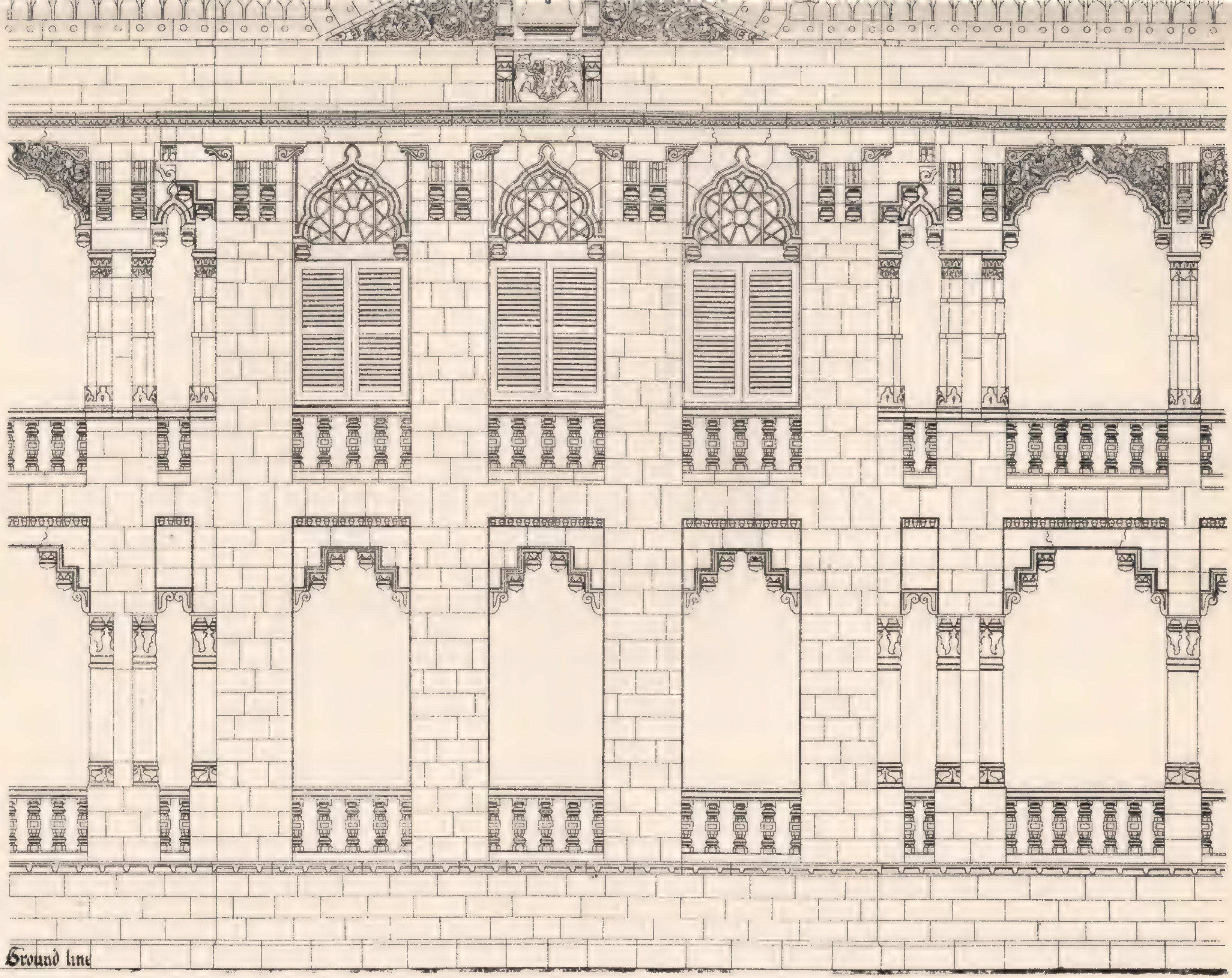


FIG. 138. CENTRE OF THE FRONT ELEVATION OF HOSPITAL.

SCALE OF 10 5 0 10 20 30 40 FEET

W. Emerson del.

C. F. Kell, Photo-Litho. Castle St. Holborn, London, E.C.

IX. A DESCRIPTION OF SOME BUILDINGS RECENTLY ERECTED IN INDIA. (XXXIV.)

THE TAKHTSINGJI HOSPITAL, BHOWNUGGUR.
DETAILS OF STAIRCASE.

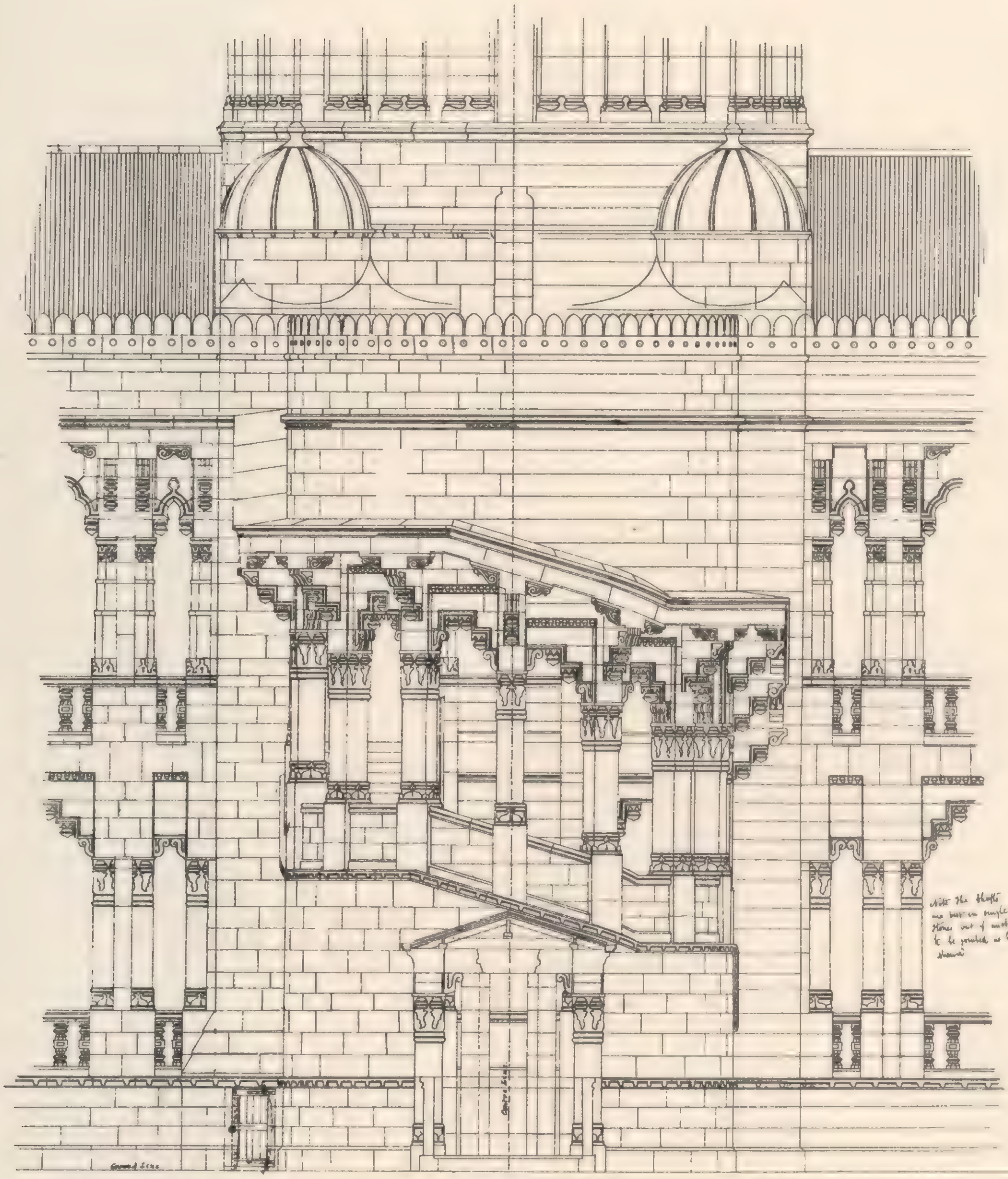
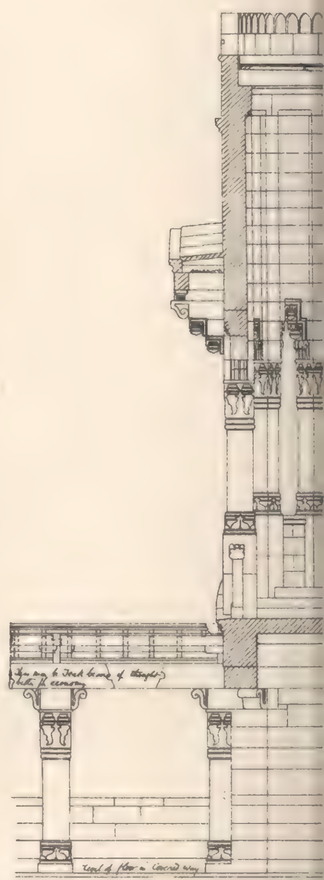


FIG. 140. FRONT ELEVATION OF THE STAIRCASE.



FIG

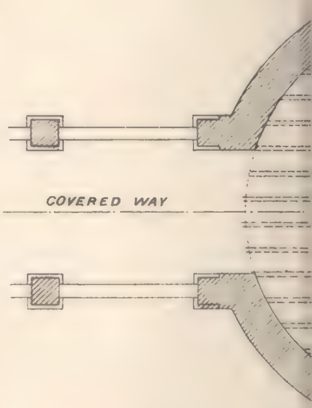
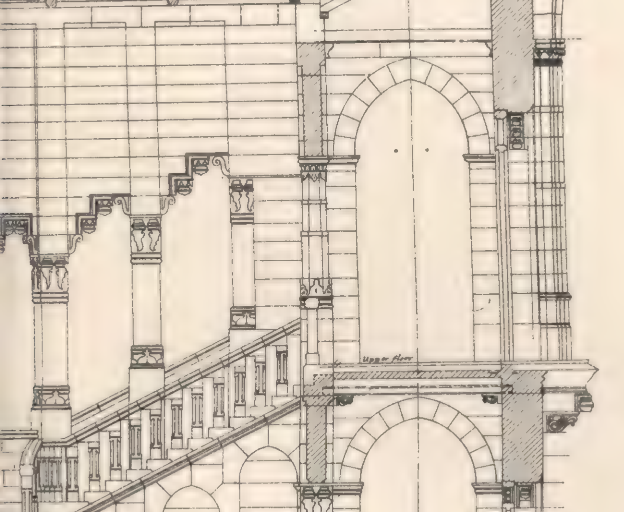


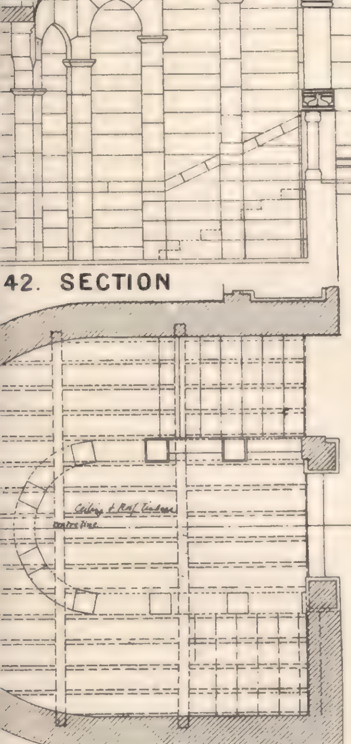
FIG. 141. PLA
(AT LEVEL O

W Emerson del.

SCALE OF 10 5 0 10



42. SECTION



OF THE STAIRCASE.
(... THE COVERED WAY.)

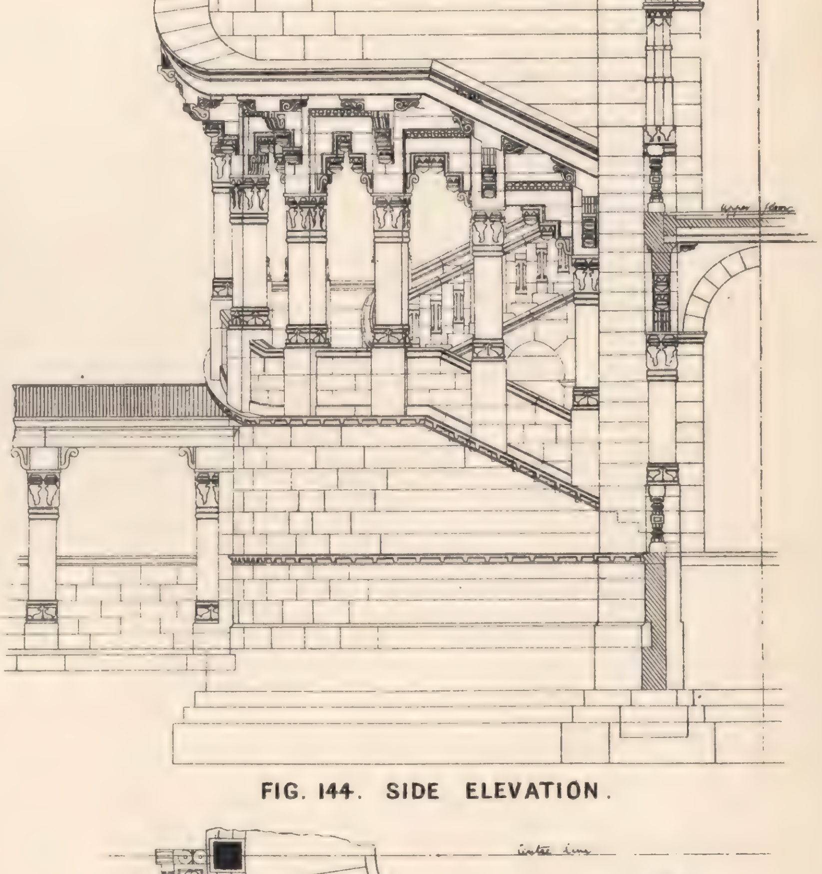


FIG. 144. SIDE ELEVATION.

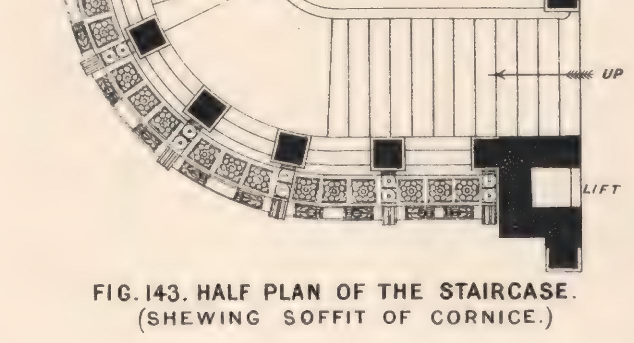


FIG. 143. HALF PLAN OF THE STAIRCASE.
(SHEWING SOFFIT OF CORNICE.)

20 30 40 50 FEET

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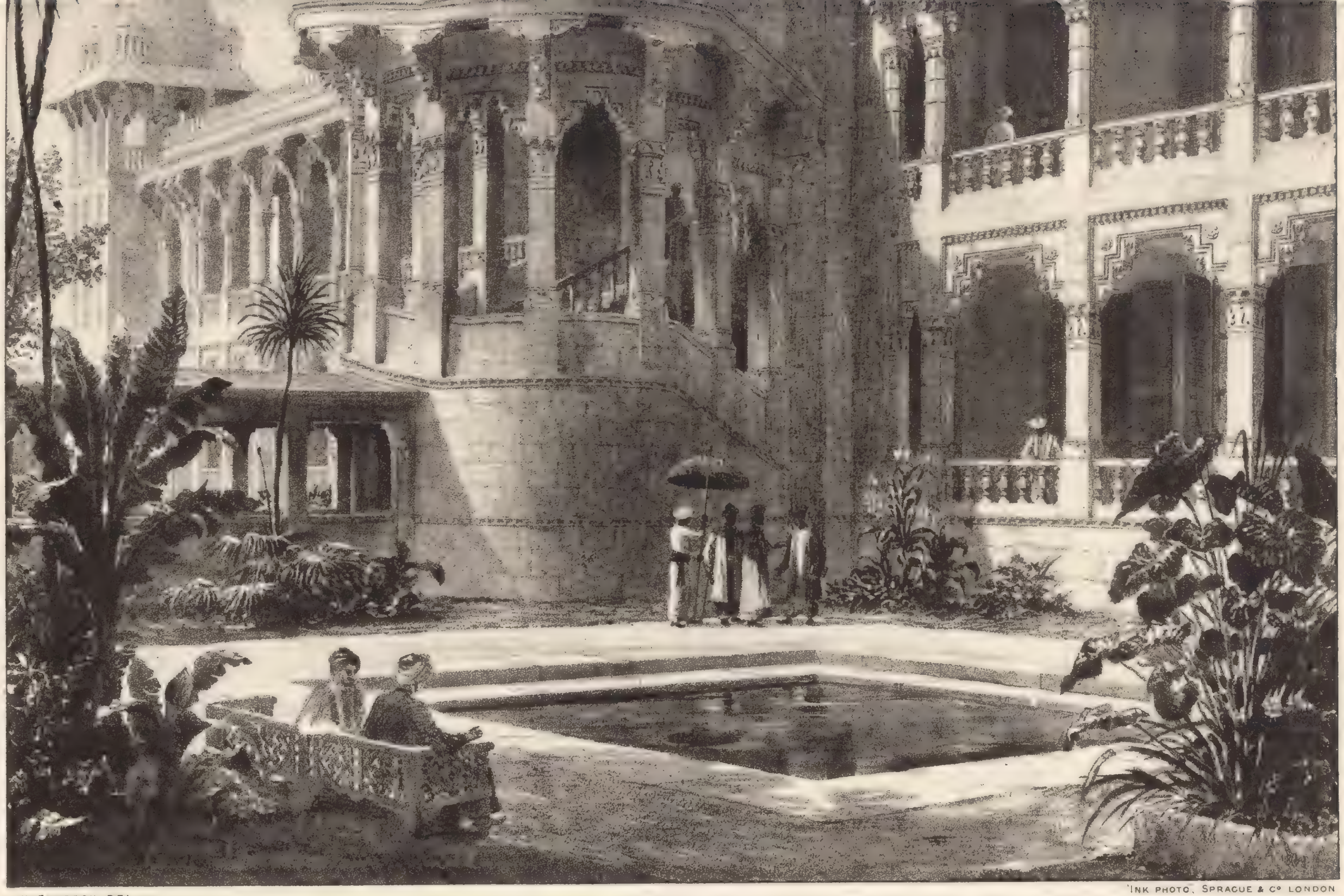
IX. A DESCRIPTION OF NEW BUILDINGS RECENTLY ERECTED IN INDIA (xxxv.)



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INK PHOTO, SPRAGUE & Cº LONDON

THE TAKHSINGJI HOSPITAL, BHOWNUGGUR.

FIG. 145. VIEW OF THE DOME AND STAIRCASE.

IX. A DESCRIPTION OF SOME BUILDINGS RECENTLY ERECTED IN INDIA. (XXXVI.)

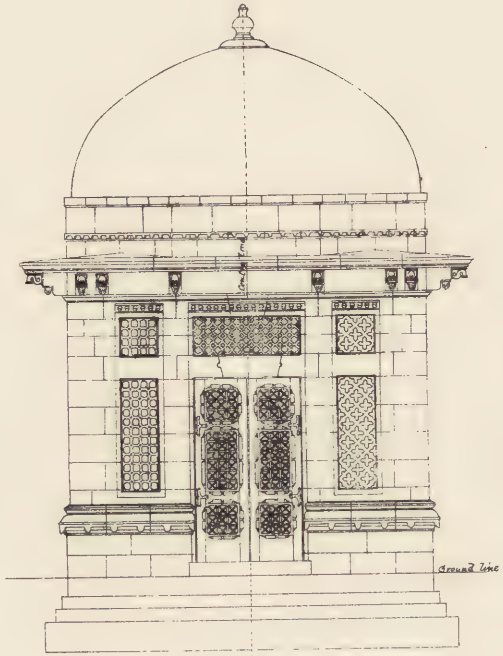


FIG. 147. ELEVATION.

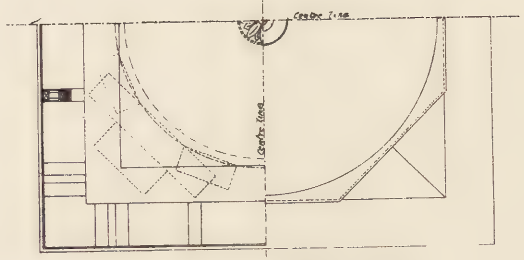


FIG. 149. QUARTER PLAN
LOOKING UP. LOOKING DOWN.

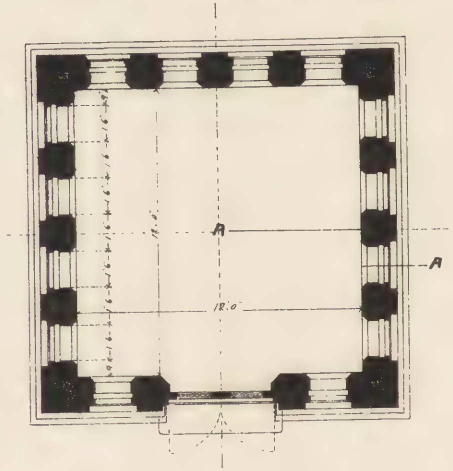
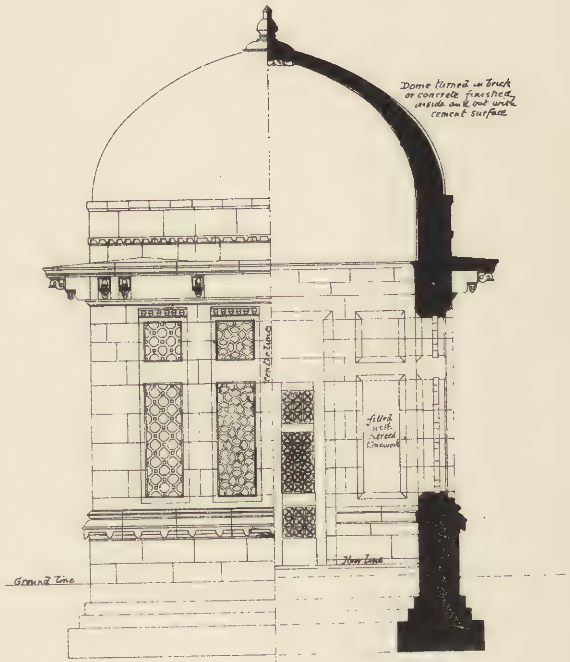


FIG. 146. PLAN.



HALF ELEVATION. HALF SECTION ON LINE A.A.
FIG. 148.

SCALE OF 10 5 0 10 20 30 FEET

THE MORTUARY OF THE TAKHTSINGJI HOSPITAL, BHOWNUGGUR.

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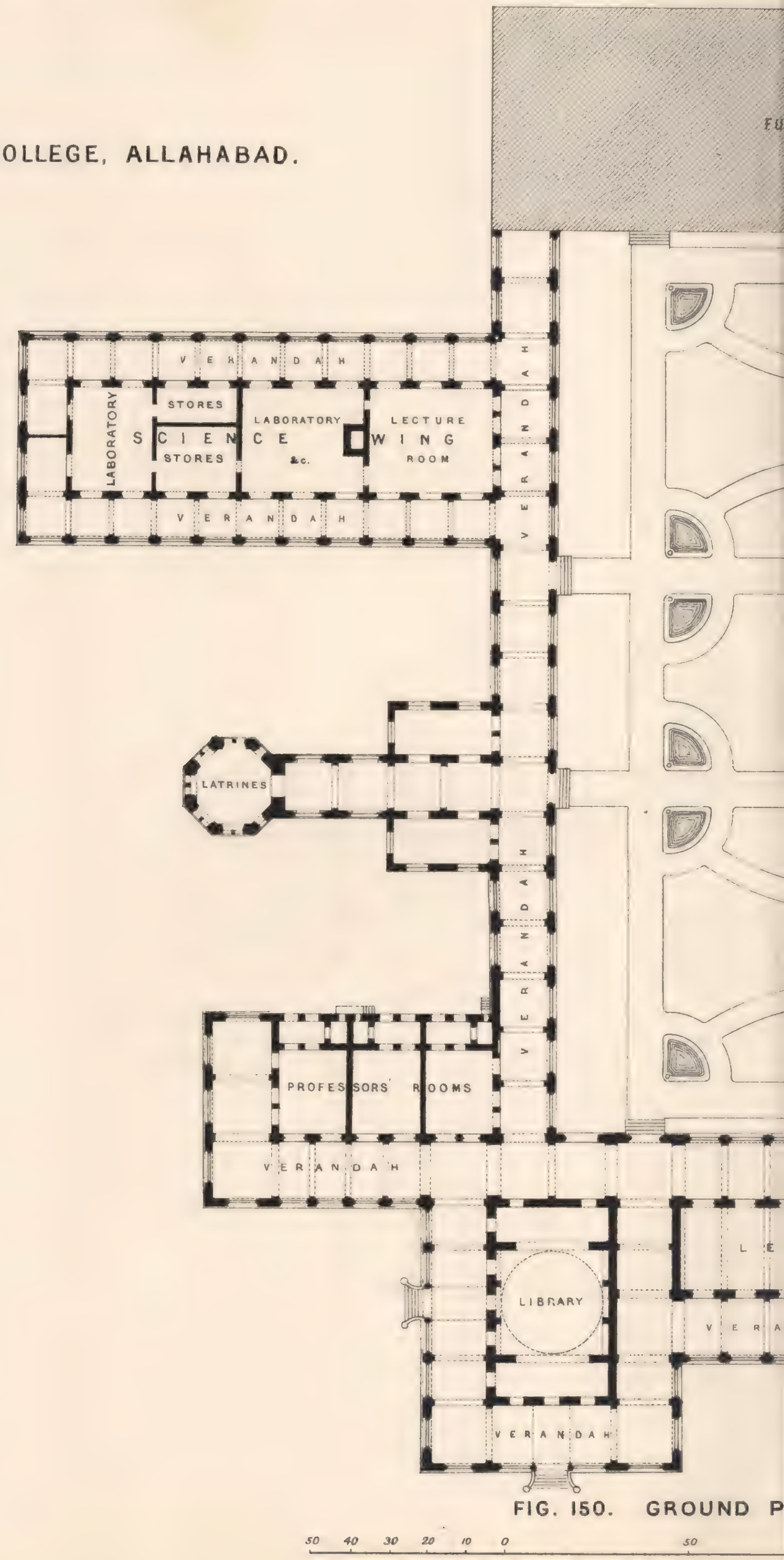
J. F. Kell, Photo-litho, Castle St. Holborn, London, E.C.

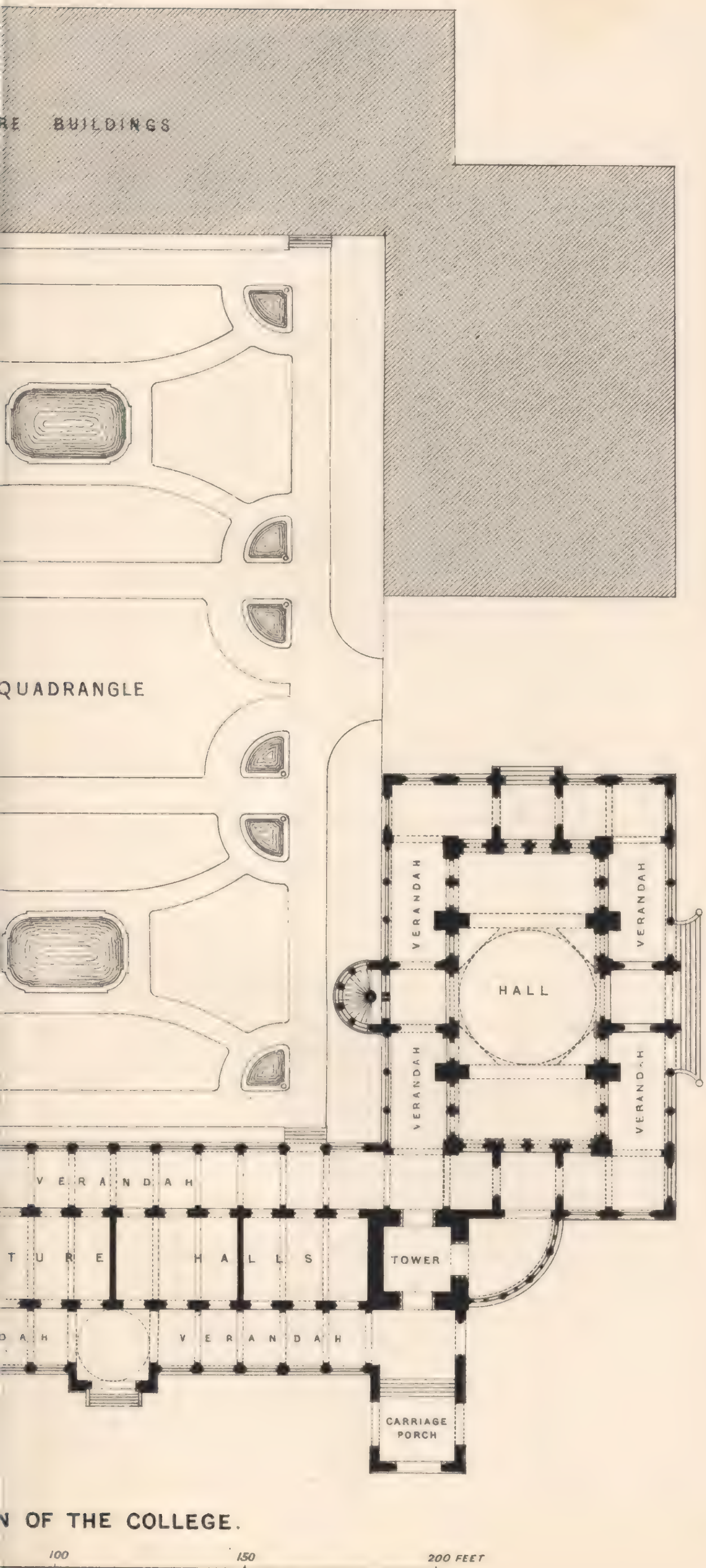
IX. A DESCRIPTION OF SOME BUILDINGS RECENTLY ERECTED IN INDIA. (XXXVII).

THE MUIR COLLEGE, ALLAHABAD.



W. Emerson del.

FIG. 150. GROUND P



N OF THE COLLEGE.

C. F. Kell, Lith. 8 Castle St. Holborn, London E.C.

IX. A DESCRIPTION OF NEW BUILDINGS RECENTLY ERECTED IN INDIA (XXXVIII)

W EMERSON, DEL

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THE MUIR COLLEGE, ALLAHABAD.

FIG. 151. THE QUADRANGLE.

W. EMERSON, DEL.

"Ink-Photo" Sprague & Co. London, E.

THE MUIR COLLEGE, ALLAHABAD.

FIG. 152. THE LIBRARY.

quarters of the globe, hinting that the researches of science in this Institution extend to the whole universe. Unfortunately the Mohammedan religion precludes the representation of any living thing, so that figure ornamentation could not be introduced.*

The decoration of the library dome was suggested to me by a Hindoo temple I saw at Pashan, near Poonah. The cartoons were drawn in England full size, and coloured to show finished effect, so that they would only require transferring and copying, but inasmuch as colour looks very different when at any distance from the eye, I imagine they will find it rather difficult to get the right effect, for there are not many decorators to aid them in India. The decoration of the larger dome over the Hall is simpler, being further from the eye, and is a pattern of oyster shells with a dark red design on light red ground. The colour is introduced in a manner to obtain just a warm effect without covering too large a proportion of the wall surfaces. There is a painted pattern on the vaults at the ends of the Hall. The wall tiles used internally are from the Bombay School of Art, and the domes are covered externally with Indian tiles.

In the Takhtsingji Hospital, which is erected by His Highness the Thakore of Bhownuggur, a fresh chance for a new departure presented itself. Being a Hindoo the Thakore did not wish to have a modern rendering of Mohammedan architecture which had been carried out in nearly all the new buildings of late years, but wanted something with more of a Hindoo feeling. This was rather difficult to get, but I adopted for this reason the corbelling construction instead of the arching, and by the introduction of certain Hindoo detail, I managed to obtain the effect shown in the perspective. But I could not confine myself altogether to Hindoo work, and in the dome I utilized the pendentive construction shown in the tomb of Mahmoud at Beejapore.

One of the most interesting points in these works to me was the chance of introducing domes, which rarely happens to an architect practising in England. In the dome over the Hall of the Muir College, I have taken the type of the Taj Mahal for outline. It is, no doubt, thicker than is necessary, but as it was not to be carried out under my supervision, I thought it best to make it strong enough. The extra thickness at the bottom, to bring the line of thrust within the wall of the drum and to insure increased frictional tie, is obtained with the least amount of extra weight by the introduction of internal arcading. The lantern being open, the minimum amount of vibration would be caused by wind. This dome is built of brickwork at the springing, lightened by a gradual decrease of thickness as it rises, and by the introduction of earthenware chatties or pots and hollow drain-pipes in the upper portion. It is 34 feet in diameter, or only half the size of the one Mr. Chisholm described last year, which he erected at Baroda. The drum becomes octagonal over the pendentives, thus obtaining extra thickness and strength at eight points; it is buttressed on all sides by the adjoining roofs and arches, and, of course, the square angles below give great additional stability. The piers are of solid masonry in large stones. The pendentives are treated in the cellular manner peculiar to the Indian Mohammedan architecture frequently found in the North-West Provinces and the Punjaub. The decoration in these instances is usually by

* The natives in some parts, notably in Bombay, do very good carving and sculpture. The whole of the carving in the elaborate Fountain in the Bombay Markets was produced by the native carvers, under the direction of Mr. Kipling, at that time one of the Superintendents of the Bombay School of Art.—W. E.

accentuating the arrises of intersection of cells by black lines, or white lines on colour, giving somewhat the effect of honeycomb if you can imagine the cells lozenge-shaped instead of hexagonal.

The library dome [Illustn. xxxix.] is smaller, being only 26 feet in diameter, and is octagonal on plan. The pendentive arrangement also is different, and is formed by the intersection of two semi-circular vaults. The construction is of brick and similar to the first.

The Hospital dome is of different construction altogether; it is of concrete cast in moulds by Mr. Lascelles, and was built up in London before it was sent out to India. I wished to give a rich internal effect of ribs ornamented with the pendants shown in detail, and to do it without great expense or heavy centering, &c. The ribs are in two lengths and formed of concrete with T iron core, and when erected can be bolted together at the centre, and the slots filled in with cement. The iron being embedded in the concrete is impervious to the atmosphere. These ribs could be raised and fastened to the ring at eye of dome with slight hoisting apparatus, and then the external covering of concrete slabs simply laid on. The concrete at bottom of dome is composed of heavy gravel, marble chippings, slag and cement, while the upper portions are of coke breeze and cement, and little heavier than pumice-stone. This dome was set up in London with loose joints on brick piers and stood for some weeks, the ribs being bolted together [Illustns. xxxii., xxxiii., xxxv.].

In each of these domes iron ties have been introduced, but I think they are not necessary to the construction; iron was not used in any of the thousands of the Oriental domes.

In Turkey, Egypt, Persia and India, there exists a variety in the forms of domes, and all are different to those we are accustomed to see in the churches of Italy and elsewhere on the Continent,—of the ordinary type of outline and construction you have seen adopted at the new Church of the Oratory, at Brompton. The Oriental dome is varied in outline and is different in construction and detail.

The common form of Indian domes in Jain work I have not troubled to show; you can find all about them in Mr. Fergusson's History of Architecture. I mean the principle of cutting off the angles of the square substructure by triangular stones, and the reducing the area again by long side stones and so on, until the centre is covered by one square slab. This is hardly what is understood by the term dome now-a-days, and does not bear upon what I am going to say. Nor have I shown the horizontal construction of the Indian and earliest Greek type, as from their size these structures seem hardly to deserve the name of "dome." But once enter the Pantheon at Rome, or the Gol Gomuz at Beejapore, and a due appreciation is felt of what the word "dome" really signifies. Still, grand as the Pantheon really is, it is natural to find it much less scientific, from a constructional point of view, than others erected at a later date. It is the rough and ready method of loading the haunches with vast weight to insure stability, necessitated partly by the spherical shape of the dome itself, and partly by the circular plan of substructure.

A progressive increase of scientific skill in construction is exhibited since the time of the Pantheon, shortly before Christ, in the domes of the tomb of the Shah Khoda Benda at Sultanieh in Persia, erected in the fourteenth century; the Duomo at Florence in the fifteenth century; St. Peter's at Rome in the sixteenth century; St. Paul's in London in the seventeenth century; the Tomb of Mahmoud at Beejapore, and the Taj Mahal at Agra in the seventeenth

century also. When pendentives came into use, the angles of the square substructures gave a much greater increase of stability, and I suppose caused so much more thought to be expended on the principles of domical construction, that the culminating and most ingenious arrangement both for pendentives and balance of weights was arrived at in the Beejapore system, exemplified by Mahmoud's tomb.

The very bulbous shape of the Ebrahim Rosa at Beejapore and others, like a turnip upside down, does not appeal to my sense of the beautiful, and though I have heard it said it was simply introduced to please the Oriental fancy, I cannot but think there was some constructional reason for it,—probably to get more weight and extra frictional tie by width at the haunches where the thrust is greatest; when once this thrust is overcome by increased weight which, by reason of its position and radial joints tends to fall inwards, it is diverted into almost a vertical direction, and the overhanging of the stones externally counts for nothing.

Mr. Chisholm last year described the dome he has erected at Baroda, of the mode of construction of which I do not quite clearly see the object. It is a double dome without a lantern, or rather a ribbed conical vault with panels, and an external dome supported on the ribs. I believe it was considered less expensive to obtain the thin conical dome with direct thrust to the springing, and then support on it the bulbous one for external effect, than to take a middle course as at the Taj Mahal or Sta. Maria at Florence, and give increase of thickness at the base sufficient to allow of a more pleasant outline than the section of the internal cone shows. But I should have thought the heavy ribs over haunches and double thickness at top more than counterbalanced the cost of a thicker base and tapering crown, besides being less stable.

A double dome like St. Paul's is I think wrong; it seems to aim at being, not only a grand roof to a large area, but also obtaining the effect of altitude belonging by right to the tower and spire, and in this respect I think appreciation of the true relation a dome should bear to a building is better shown by the Oriental than by Sir Christopher Wren. The Taj is, no doubt, chiefly the work of an Italian,* and that would account for the use of the double dome there. Moreover, it was evidently not desired to pierce the drum, as even then the interior of the dome could not have been seen. In St. Peter's at Rome, and in the Duomo at Florence, the double domes were evidently made to insure the stability of the lanterns, and for this reason are advantageous.

A moderate height and a single dome without striving after a fictitious external altitude is best; and if a high point for grouping purposes is necessary a tall lantern or spirelet would give it. The Orientals evidently thought so, and moreover they knew what the Westerns have failed to discover, that it is a far easier thing to construct a dome than a tower or spire, and so much so that I suppose for every tower or spire in Europe there must be at least fifty domes in the East. Mr. Fergusson says it is as difficult to build a dome that will fall as it is to build a Gothic vault that will stand, and I imagine it is true: provided the abutments are strong enough, a fairly carried-up dome with tapering shell would be difficult to build so that it would fall.

The constructional eye can clearly see that the most stable shape for a dome is the conical or Gothic, the shell tapering as it rises to the crown, and with sufficient weight on the haunches to counteract the outward thrust, thus bringing the point of greatest thrust as near

* See Mr. Emerson's Paper on the Taj Mahal in the TRANSACTIONS, 1869-70, p. 195.

the base as possible. To increase the weight at haunches a slightly bulbous form might be advantageous, and also I think it would be a good plan, though I have never seen an example of it, to carry round internally, at 20 to 30 degrees above the springing, *i. e.* at weakest point according to section of dome, a heavy projecting cornice, whose tendency would be to fall inwards, thus counterbalancing the outward force at the point where it is most needed. And I can imagine that were this feature introduced into Gothic architecture a delightful effect with ribs and panels working into the projecting mouldings might be obtained.

It seems to me that the best domical construction obtainable would be a combination of the arched pendentive arrangement of Mahmoud's tomb, surmounted by a circular dome of the conical section of St. Peter's at Rome, or Sta. Maria del Fiore at Florence, or that of the Tomb of the Shah Khoda Benda at Sultanieh, with a slight additional bulbousness of the haunches and a weighty cornice hung inside about one-third of the height above the springing. Of course if a very high or large lantern were required a double dome or ribs might be introduced. I believe St. Peter's and Sta. Maria at Florence *would* have been equally strong, and certainly of less weight, if the conical domes had been made gradually thinner towards the summit. Part of this idea was in my mind when I made the design for the dome over the Sitzungsaal, in the competition for the Berlin Houses of Parliament. In this case I proposed supporting the large lantern by flying buttresses over the dome instead of by a double shell. One good point of this construction internally would be that the spandrils would offer such advantages for mosaic or fresco, being at an easy angle of vision—an important thing at a great height. I believe that with Portland cement concrete, and a net-work of iron or copper embedded in it so that the atmosphere could not affect the metal, to supply the fibrous quality concrete needs, the upper part being composed of an aggregate of light specific gravity with heavy material at the base, we might construct perfectly stable domes of larger size than any ever yet built, and of more effective external and internal design and of comparatively light weight.

Internally the dome is by far the grandest and most impressive method of covering a large area. There is a mystery about the gloom of the interior of a vast dome that well suits the imagination of the Oriental. And in all great architecture there should be a myteriousness. I have read that a science without mystery is unknown, and a religion without mystery is absurd, and I am sure we may add that architecture without an element of mystery is unpoetical and unimpressive. It is this quality in our great Gothic cathedrals caused by the ranges of columns, arches and vaults, that is the chief reason of their attractiveness, but they lack the feeling of immensity and spaciousness which the dome gives. A dome should not be too light nor its vastness too easily penetrated. I think the effect of St. Peter's is marred by this, and the interior of St. Paul's is more effective. Some will say how about the decoration? Well the decoration of St. Peter's is too plainly visible, and if St. Paul's is treated correctly, with well designed subjects possessing strong outlines, devoid of dark shadows and rendered in the brightest glass mosaic, the decoration of the dome will be quite visible enough down below, with sufficient mystery to be emblematical of the mysterious nature of all spiritual and heavenly things.

But for decoration in such a position the colours must be brilliant,—distance and the atmosphere will dull an emerald green down to grey, and a bright vermilion to dingy red.

I have often wondered why our architects, who have had the chance, have never erected

a dome in connexion with a Gothic church in England. It is needed; as our enormous congregations prove, many of whom can neither see nor hear on account of the blocking up of the churches with enormous piers. I want to see a magnificent Gothic interior opened up after the manner of the Duomo at Florence and like numbers of Italian churches. I do not see why the grandest of all features should almost exclusively be found in Classic and Oriental work. There may be certain difficulties to be overcome but nothing insurmountable, and with the earlier types of transitional architecture the dome would harmonize perfectly. Might it not be that in such an endeavour to unite Classic and Gothic we might perchance strike the keynote of the architecture of thirty years hence, as suggested by Professor Kerr in his interesting Paper? * Let it be a renaissance suited in every way to our modern requirements: not the renaissance of a fifteenth or sixteenth century Italy, but a renaissance of the blended spirit of Classic and Gothic, exemplified in some such works of an earlier century as those I have already mentioned at the commencement of this Paper. A renaissance whose arms shall be long enough and bold enough to embrace the lintel, the round arch and the pointed arch, the picturesqueness of the Gothic vault, and the dignified nobility of the Classic and Oriental dome; where the crudities of Gothic art shall be eliminated, and the refinements of Classic art introduced.

Before such an architecture, a style whose sole god is quaintness, whose highest ideal of nobility is summed up in the word "picturesque," and whose details and sculpture are debased and meaningless, may surely retire into the indistinct haze of oblivion from which it was evolved. But I do not mean a renaissance whose constructive element is iron. Let that suffice for bridges of thousands of feet span, for earthquake-proof buildings, for fire-proof floors and roofs, for warehouses, girders and ties, &c. An architecture to be noble and impressive must not be deficient in mass, and an iron edifice is but a skeleton wanting the clothing of sinews, flesh and skin, to give it life and beauty; and if from the human skeleton life has departed, I feel sure that on the same principle an iron architecture will be found wanting in the spirit, beauty and nobility of a living art.

WILLIAM EMERSON.

[Remarks by R. F. Chisholm, *Fellow*.]

While acknowledging the excellence of Mr. Emerson's interesting Paper, I can fully endorse all that he has said in regard to an architect's difficulties in India, and it would be by no means difficult to add to the list. It is both difficult and expensive to learn anything about Indian art in India, and many journeys must be taken and much time expended ere one obtains that connected idea of the subject necessary to work in native styles. The government of India and the Local governments have done so much for archæology, that if the subject is not now fully illustrated, it is more the fault of the material at the disposal of Government than any lack of proper interest. Although there are still points of great moment to be settled, the whole subject of archæology is now placed on such a sound footing, and the materials are being so methodically collected, that the dead should in my humble opinion rest

* See page 218 for Professor Kerr's Paper.

satisfied. Not so the living; research up to the present time has been almost exclusively of an archæological or picturesque character, and although acknowledging these investigations to be indispensable, it is very necessary to supplement them with information and illustration of a more architectural character before they can be of any practical use. When the Government appointed a conservator of ancient monuments some three years ago, I for one hoped that at last some of the magnificent buildings, of comparatively little value from an archæological point of view but invaluable to the practising architect, would have received attention and proper illustration. Although we have had numerous excellent pictures, endless photographs, and general descriptions, there is nothing which I have seen which would enable a practical man to construct a native cupola of even moderate dimensions. He must throw all published matter aside, and travel frequently hundreds of miles for his model. I am speaking more particularly of the south of India, where my own lot has been cast. Now we all know in active practice a man has little time to generalize beyond his immediate requirements, and in the process of selection and rejection for any particular purpose I have felt myself very keenly the actual want of those publications, which so materially lighten the labour of an English architect. I have scarcely ever adopted an appropriate form or treatment of a form without discovering later on a more appropriate form or treatment, and I have frequently rejected as an innovation an expedient for which I afterwards found ample authority. With regard to domical construction, I do not think I can add to what I have already said in this room. A point which may be worthy of notice is the different conditions under which we moderns build. In all old Eastern domes the supports were either solid walls or a series of concentric points of support. Neither of these arrangements would satisfy modern requirements, where the dome covered space must be both well lighted and well ventilated, and when the material is principally brick the problem becomes even more difficult. In Baroda, after securing the maximum of supporting power compatible with convenience, light and ventilation, the problem I set myself was to construct a dome with certain external effects, without unduly weighting these supports. By adopting the double form, and relying on the inner dome for strength, it is quite possible to make the outer form pointed, bulbous or any shape, without unduly affecting the stability. It is also perhaps worthy of note that the Eastern pointed arch is peculiar. Although arches are to be found struck from two centres, like the early Gothic, in general the centres are close together, or one centre only is used, the point at the apex being formed either by tangents to the curve or lines of reflex curvature, and the arch is invariably stilted. It is astonishing how soon the eye becomes tutored to this form of arch. Another matter—it is extremely difficult to design a dome which will look equally well from all points of view. A dome which looks well at a moderate distance will appear stunted and over-curved, so to speak, from a near point of view; and a dome entirely satisfactory from a near point appears stilted from a distant one. In the Eastern dome the tangential or reflex curve, as the case may be, at the apex, raises the finial, so that it is well kept in view until eclipsed by a comparatively low ring of domework. I have no particular affection for my dome at Baroda; it is simply an example of a modern dome constructed of brick, without the aid of centering of any kind, and containing, I think, a smaller quantity of material than any dome of its size, the area of support being about one-ninth of the area covered, and the pressure per superficial foot about 5 tons. If it falls to my lot to construct another dome, I think I shall

adopt the expedient of a tie with live weights to counteract the thrust. The chief difficulty connected with cheap domical construction lies in the tie, and unless we can build domes cheaply they will never come into general use. The only material perfect in tension is metal, which is objectionable by reason of its sensitiveness to thermometric change, to meet which difficulty I would adopt the following expedient. At any convenient number of points, say for instance twenty-four in the whole circumference, I would run metal ties horizontally towards the centre, equal in length to about one-third of the radius. I would connect all the inner ends by ties parallel with the chords of the arcs, and suspend weights which would exert a pull equal to the thrust. Variations of temperature would then merely cause the weights to rise and fall slightly. I believe by some such expedient a very small amount of material would satisfy the conditions of permanent stability. If I were building for myself, with my own money, I would not hesitate to run thicknesses much finer than I have done at Baroda.

R. F. CHISHOLM.

[Remarks by George Aitchison, A.R.A., *Member of Council.*]

The first and greatest dome with which we are acquainted is that of the Pantheon at Rome, about 140 feet in diameter, built about 27 B.C. It must have been built just before, or just after, the death of Vitruvius ; for though he speaks of domes, as represented in painting, as covering the circular cellas of Tuscan temples, and as the covering for the hot chamber of the baths (Laconicum), he could hardly have omitted any mention of so magnificent a structure as the Pantheon, nor failed to speak of its construction and centering, if it had been built before he wrote his book. I believe nothing was known by the moderns of the method employed in constructing this dome, until it was discovered by Piranesi when he repaired the internal plastering, and found some remains of the bronze work still adhering to the coffers, during the papacy of Benedict XIV. In Piranesi's magnificent work he gives the construction, showing that it was not a real dome at all, *i. e.*, not composed of horizontal circular rings whose beds were normal to the curve, but composed of two rows of discharging arches with ribs springing from the middle of the lower row [Illustn. xl., fig. 153]. Diocletian reigned from 284 A.D. to 305 A.D. : in this interval he built his palace at Spalatro, containing a circular-domed temple to Jupiter. R. Adam published his work, *The Ruins of the Palace of the Emperor Diocletian,* in 1760, and one of his views of the interior of this temple shows the construction of the dome where the plastering has fallen off. It is in this wise :—Eight semi-circular discharging arches spring from the points where the internal columns stand ; the spandrils of these are filled with concentric rings rising to the level of the crown of the large arches, forming eight large and eight small arches, and above this are sixteen solid arches of concentric rings [Illustn. xl., figs. 154, 155]. The cause of all this elaborate work puzzled me, and I came to the conclusion that it was for ornament—as R. Adam seemingly had too—and that the plastering was a subsequent addition, until Viollet-le-Duc published the 9th vol. of his *Dictionnaire* in 1868. Viollet-le-Duc did for the various sorts of constructive architecture what Cuvier did for the antediluvian animals, he re-created them from the fragments of the past ; he showed us that the Roman architects were troubled by the cost of centering and its

shoring, a cost that seemed thrown away; and that these great constructors set their wits to work to lessen this expense, and to this end tried to save shoring from the ground, to make the centering as light as possible, to build it of the most worthless wood probably cut green, and to delay as little as possible the continuous labour of that army of slaves who laid the rubble. This network of discharging arches did not put one-third of the total weight on the centering, for of course the inner rings were not put in till the dome was complete in skeleton, and when it was formed and keyed-up there was no fear of the centering getting forced out of shape by unequal loading, nor did the shrinkage of the timber matter; and no sooner was this network formed than the slaves worked on from the piers and solid walls with the horizontal courses of rubble. We have unfortunately to guard against Viollet-le-Duc's brilliant theorizing, for it seems that Piranesi only saw the arches in the dome of the Pantheon on the soffit, and not on the top, so that the lower shell is only due to Viollet-le-Duc's imagination. The Roman architects were not so logical as he gives them credit for being, and evidently trusted more to tactics than strategy, as those upper arches in the dome of the Pantheon testify, for they could only have been put in when the filling in was advanced to their springing. We find, too, in the Basilica of Constantine, the small coffers were artfully arranged in the ribs, in a manner quite opposed to our notions of constructive truth [Illustn. xl., fig. 156]. The same sort of device was resorted to by the Roman architects in the formation of their grand vaults, either a thin shell or arch of double tiles was put over first [fig. 156], sometimes stiffened by ribs, or by projection to connect them with the rubble [fig. 157], or the whole vault was formed into cells [fig. 158], as shown by Viollet-le-Duc's pupil, the engineer M. Choisy. I may here mention that the plan of building vaults of single tiles laid flat and afterwards covered with concrete was still practised in Tuscany in 1854. I saw a room being vaulted in this way without centering, but with turning-pieces about 6 feet apart; the tiles were held in their places solely by plaster of Paris. I shall not trouble you with descriptions of the flat dome of Sta. Sophia at Constantinople, built of pumice stone or light bricks, nor with that of the dome of San Vitale at Ravenna, built with hollow pots (though I may remark that Mr. Cockerell, the father of the Professor, used hollow pots for building a vault at the East India Company's warehouse in Cutler Street, London), but pass on to the modern domes built to vie with that of the Pantheon at Rome. The first of these was the dome of Sta. Maria del Fiore, built by Bruneleschi in 1419. He undertook to build this vast dome, only a trifle less in diameter than the Pantheon, without internal centering, and did it. Curiously enough, the way in which this feat was accomplished, which so astonished mankind, has not come down to us, though the sketch of his internal scaffold has [Illustn. xli.] And it is a point worthy of your consideration whether this had resistance enough to overcome the tendency to fall inwards of the bricks forming the upper rings until the whole course was keyed up. I think we must regard his double shell as merely a device to lessen the weight, *i. e.* that it is to be looked at as a single shell with voids. The dome at La Mousta in Malta was built in this century without internal centering by the simple device of rabbeting the bricks for the upper courses. Little need be said of St. Peter's, which structurally speaking is but a copy of Florence, except that the inner dome is much flatter; and it was hoped that the more pointed outer shell would safely carry a large lantern, though the domes from their completion have been constantly cracking, and been hooped with iron. Wren, who was a mathematician as well as an architect, was determined to make his lantern

IX. A DESCRIPTION OF SOME BUILDINGS RECENTLY ERECTED IN INDIA. (x)

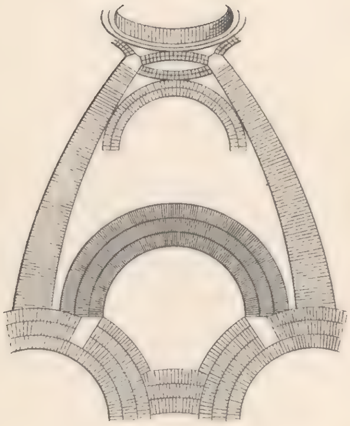

FIG. 153.

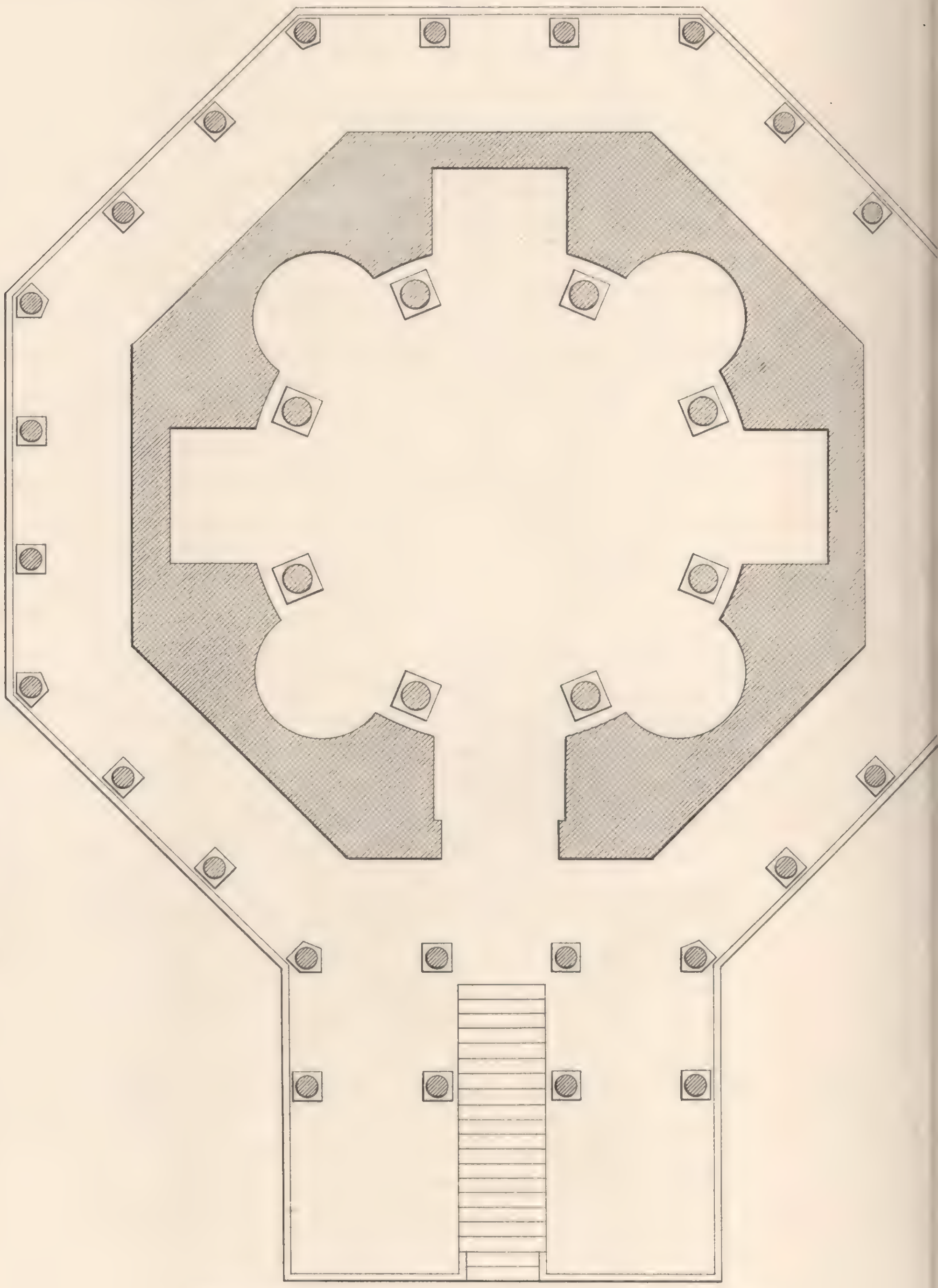

FIG. 154.

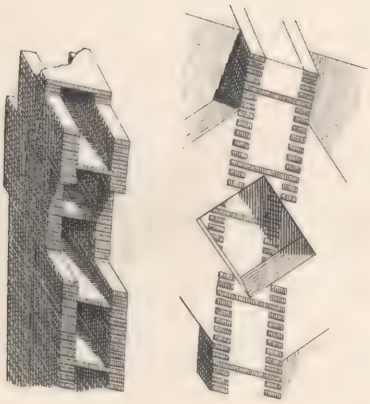

FIG. 156.

G. Aitchison del.

DIAGRAMS ILLUSTRATING

(See Page

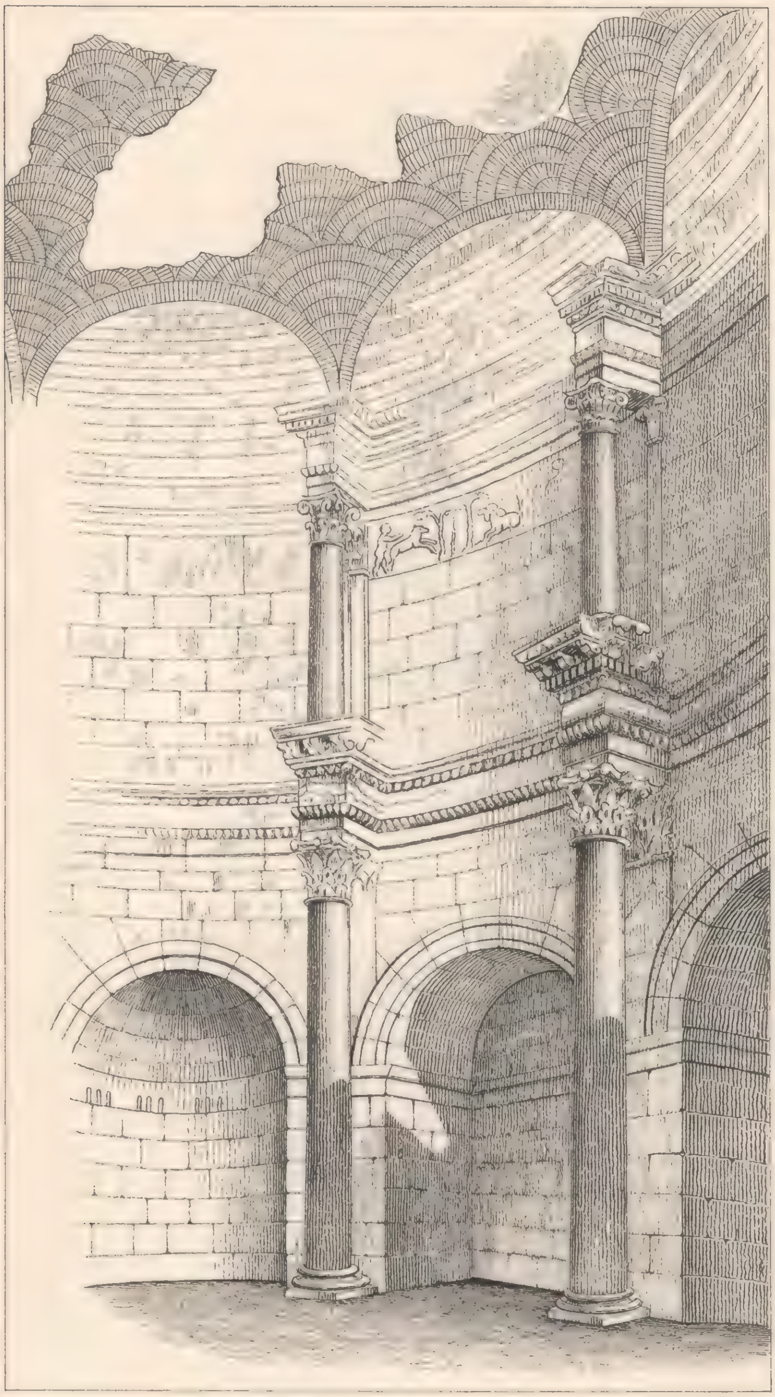

FIG. 155.

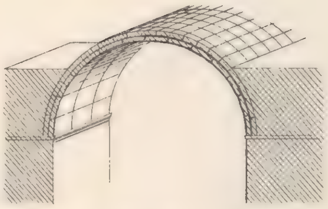

FIG. 156.

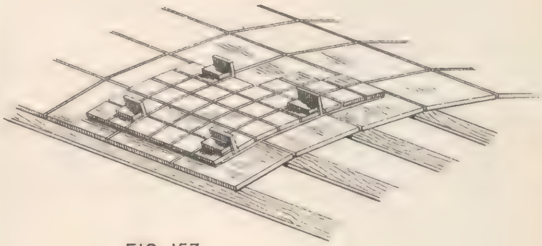

FIG. 157.

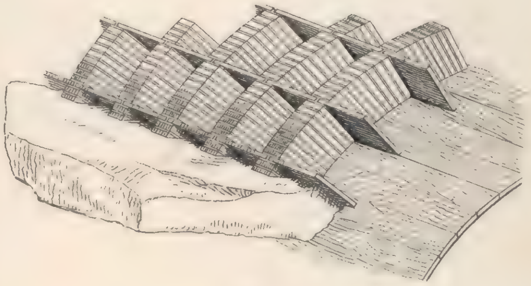

FIG. 158.

Mr. AITCHISON'S REMARKS.
(159-161.)

C. F. Kell, Lith. 8 Castle St. Holborn, London, E.C.

IX. A DESCRIPTION OF SOME BUILDINGS RECENTLY ERECTED IN INDIA. (xli)

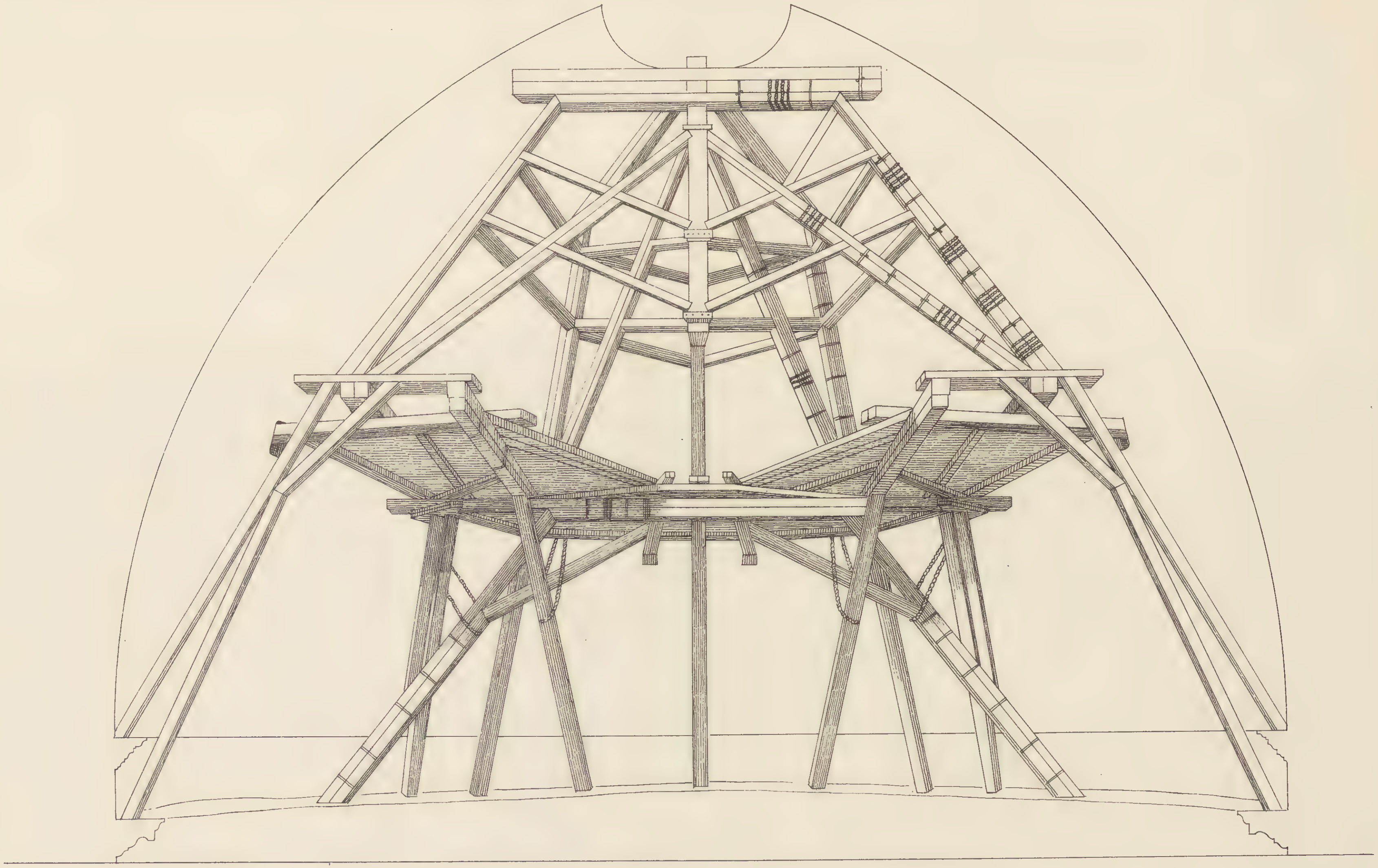

FIG. 159. SCAFFOLDING USED IN THE ERECTION OF THE DOME OF S^TA MARIA DEL FIORI, FLORENCE.
DIAGRAM ILLUSTRATING M^R AITCHISON'S REMARKS.
(See Pages 159-161.)

F. Brunelleschi inv et del

C F Kell Lith 8 Castle St Holborn London E C

safe, and so carried it on a brick cone, and made his inner or real dome of stone and the outer one of wood. The ingratitude of mankind to its greatest men is proverbial, and I fear I have not been an exception; for there can be little doubt that Wren regretted the necessity of making his outer dome in wood, but without sufficient funds for a stone one what could he do? St. Paul's was finished about 1710, Mansard died in 1708, and Soufflot was born in 1714. Wren, Mansard and Soufflot, had three separate structures—an internal, a middle and an external, dome; but while Wren made the external dome of St. Paul's, and Mansard the external dome of the Invalides of wood, Soufflot made his external dome of Ste. Geneviève (commonly called the French Pantheon) of stone, as well as the other two: his middle dome, which carries the lantern, though of cut stone, is of curved section, and a little thicker than Wren's 18-inch brick cone, Soufflot's being about 1 foot 7 inches thick, but strengthened by ribs.

G. AITCHISON.

[Remarks by Professor Kerr, *Fellow.*]

I think the science of dome building is one of the most refined problems in our art, and for my own part I am always delighted to hear any exposition of it from whatever point of view. It is too large a subject to discuss further than in a general way, as Mr. Emerson, Mr. Chisholm and Mr. Aitchison have done. I am quite disposed to wish with Mr. Emerson that dome building could be introduced into this country as a key-note in some novel style of architecture, and I do not see why it should not be so. I am sorry that Mr. Emerson should have introduced so much iron into the construction of the dome he has described. I understand that the structure is formed of concrete slabs with iron concealed. I think I should scarcely care to see that system introduced into Mr. Emerson's style of thirty years hence. The proper principle of construction involved in any dome, as it seems to me, is primarily that which we see used by the children in building a grotto of oyster-shells. It is not essentially a question of the radiation of joints as we are at first inclined to think: it is a question of overhanging corbelling such as the Greeks used, and of poising the structure by that means, ring by ring, until you can crown it—if you can. If you look at Mr. Chisholm's dome* at Baroda, which is in section a very sharp pointed arch, you can see plainly that if it is composed of rings, bonded within themselves so as to have no thrust outwards, they will by their own weight lock themselves inwards, as it were, and you can easily understand how the builder could proceed, course by course, with more and more care as he ascends, until at last he becomes doubtful whether he can go any further without a centre; and then, if he has a sufficiently sharp-pointed section, I can quite understand that he would build the whole without a centre or any other support whatever, and without any iron. The stonework is capable of being bonded in itself, and I am very much struck with the idea which has been propounded to-night, that in hot climates it is dangerous to use metal at all. The stone thus bonded in itself—I do not mean ring by ring, but with dowels, for example, course upon course, and with broken jointing—I can quite understand that, with a sufficiently pointed arch, the whole work might be consummated without either iron ribs, chain bond, or centering. Looking at our own dome of St. Paul's artistically, this sham construction is simply a scandal

* See the TRANSACTIONS, 1882-83, page 141, Illustrations lix., lxi.

to Sir Christopher Wren's great scientific ingenuity. There is nothing but false architectural principle in it throughout. But look at the brick cone, which we all know so well structually. In that brick cone you have the pointed arch of Mr. Chisholm's dome carried still further. The brick cone is contrived for the purpose of carrying a heavy lantern in order to get an effect of altitude and nothing more. The inside and outside have absolutely nothing in common, and the result is the production of a sort of cocked-hat for the Cathedral. I should be sorry to see anyone build a dome nowadays like that of St. Paul's, at all events in England. A dome, to be a dome at all, must be built of either stone or brick—a trussed wooden cupola is no dome. Sir Edmund Beckett came down here some years ago and told us that we knew nothing about such things, and that we should find in our TRANSACTIONS an elaborate exposition of the mathematics of the matter, which he would forbear to read to us because there was only one man in the Institute who could have understood him. But I fancy that he was entirely wrong after all, and that there was not a word of real practical building science in his exposition; and for this reason, that he calculated on building a dome of loose stones. When you deal with the abstract theory of the arch, you have to consider it as being built of loose stones, and you discover that with the proper curve of equilibrium you do not even want radiated joints. Cylinders will do if they touch each other upon the line of equilibration, and even spheres will do touching at mathematical points if upon the line of equilibration. That is all very well in theory. We do not actually build arches in that way, but it is possible to understand that an arch might be so built, and would for a time hold its own. But no one would think of building a dome of loose stones, because the element of bond is a most vital consideration; and therefore Sir Edmund Beckett's argument, clever as he always is, must be said to fall to the ground, just as one of his domes would fall to the ground, for want of adhesion. In any case an arch is very much the same as a wooden truss, only that it has no tie; and it has no tie because it has immovable abutments instead. A dome is the same to some extent as a stone or brick arch, but the dome requires neither tie nor abutment, having its own tie in its circular plan if it be bonded together ring by ring. Therefore the construction of a dome is, so to speak, one of the simplest of all forms of construction, except that it is so difficult to carry into execution without special skill and knowledge. I do not see why architects, dealing with large works, should not strike out a new path in dome building, as sooner or later they must strike out a new path. Speaking of ironwork, there is one dome which we all remember, built of iron entirely, most ingeniously and most simply, over the central area of the Vienna Exhibition Building. Whether the Austrian engineers designed it, or our own Mr. Scott Russell,* matters not very much. It was a simple cone of iron work. The lantern as usual was a difficulty, but one of no great moment. The enormous cone was built with straight ribs, with of course no tie across, all radiating from the central lantern downwards to the circular wall, and having cross ribs, at intervals, forming a regular reticulation from bottom to top. As a piece of construction in iron it was absolutely perfect.

ROBERT KERR.

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* See the TRANSACTIONS, 1873-74, page 103, for the late Mr. Scott Russell's Paper on the subject of this iron dome, and for illustrations of it. The discussion thereon is at page 127.

X. PRESENTATION OF THE ROYAL GOLD MEDAL, 1884, To Mr. William Butterfield, Architect.

[Presented on Monday, 9th June 1884, Ewan Christian, *President*, in the Chair.]

THE PRESIDENT.—Gentlemen, You are of course all aware that this year the choice of the person to receive the Royal Gold Medal, the gift of Her Majesty the Queen, has fallen on Mr. Butterfield; but many of you may possibly not know, and it is therefore right I should explain, that, while thankfully accepting the proffered honour, Mr. Butterfield said that it would be so inconsistent with the habits of his whole life to appear in person publicly to receive it, that if that were a necessity he must regretfully decline.

Considering that personal appearance had in other cases been dispensed with, the Council were of opinion that this difficulty need not bar their decision as to the man.

I thought it my duty, however, when by your kindness I was elected to this Chair, to represent to Mr. Butterfield how great would be our pleasure if he would allow us to welcome him here; but having, I confess, very much sympathy with his feeling in this matter, I could not venture to ask for a change in his decision. Personally, I fear I must say that I rejoice in his determination, because, standing here as your representative, I know how trying it would be to have to say in his presence, how much I respect, both as a man and an artist, the subject of your choice.

I know no man whose whole career has been more truly honourable, or any one whose work as an architect has been more thoroughly consistent with the quiet dignity so characteristic of his life.

In the great movement for the revival of Gothic architecture, there have been according to my view, amongst others less pronounced, at least two types of men who have achieved eminence as practising architects. The prominent leaders of the cause, men of great mental and physical power, indomitable energy and restless love of work, could not fail to attract general and popular attention; but not less important to the success of such a movement have been the quiet studious hard workers, men of not less genius than the others, who in parallel lines have done so much to advance the knowledge and sound practice of their art. Of the former type two have accepted this medal, and to our sorrow have successively passed away to their rest. Of the latter, one has received it, and is still with us; but the roll of Gold Medallists would indeed have been incomplete had it lacked the name of William Butterfield.

In him we must all recognize a true master of his craft; one who not only knows well the art he practises, but whose works from first to last, whether small or large, whether in the quiet country village or in the great city, whether in the small school-house or in the grand University College: all bear uniform testimony, not only to skilful design, but to the earnest loving care which he always bestows on every detail.

It has been my good fortune to see many of Mr. Butterfield's buildings, and I can truthfully say that I have never looked upon one of them without that refreshing sense of satisfaction which good work, well carried out, must always inspire in those who can appreciate it.

Gentlemen, I hope I may count upon your sympathy in saying what I often think, that the world at large shows too little gratitude to those who minister to its improvement or its pleasure. Just as I think the poet, the great writer, the musician, the painter, should be thanked for the gratification and instruction which each in his vocation affords, so no less should the great architect; yet who ever thinks of giving him his proper meed of praise? Who ever thanked Sir Christopher Wren for his noble works in the City of London, the churches, towers and spires, with which he beautified it, or the magnificent cathedral with its glorious dome, its crowning glory? We know too well how the great architect's last days were embittered by the persecutions of men in office not worthy to tie the shoe-strings of the master, yet what a poor mean place would London have been but for the workings of his fine and cultivated genius?

Many times have I wished that I might have met in Palace Yard, and thanked Sir Charles Barry for his noble clock tower, and of many another work I could probably say the same. Truly, I think if any man earns the gratitude of nations it is the great architect, whose works are for all time an honour to his country; visible to every one who takes the trouble to see, or has the mind to appreciate the beautiful in art; and for this reason I think we have done well in offering to Mr. Butterfield the greatest honour it is in the power of this Institute to bestow.

If it be true, as I hold with the poet it is, that "A thing of beauty is a joy for ever—its loveliness increases, it will never pass into nothingness;" then, I think, we may joyfully thank Mr. Butterfield for the dignified work of his early years; the graceful and beautiful spire, and the vigorous yet sumptuous interior of his noble Church of All Saints', Margaret Street; and lest I should weary you by a bare recital of his works, passing over many others, each possessed of the power and beautiful form of which he is so great a master—glancing only at the noble Church of St. Alban, of the fine west front of which, as has been well remarked, there was lately an unlooked-for revelation; and the fine Church of St. Augustine, South Kensington—I will stop at the great crowning work of his mature years, the magnificent and richly-finished Chapel of Keble College, Oxford. In each and every one of these there is to be seen, though with great variety of composition, the same noble conception of dignified form, the same careful study of every detail for producing general harmony of work, and,—while fully availing himself of the richness derivable from the subsidiary arts in choice stained glass, mural painting or mosaics,—the same powerful mastery which fuses the whole and subordinates every thing to the architect's design.

While possessing as he does a profound knowledge of the works of the great architects of old, and availing himself of the numberless resources which they so copiously afford, Mr. Butterfield's genius has enabled him to work in a style peculiarly his own; never slavishly copying, but moulding in his own mind whatever he desired to employ in carrying out his work; and though opinions may and will differ on matters of taste, none can certainly deny that his works are those of a refined and cultivated gentleman, and a most able, original and accomplished architect.

Finally, Gentlemen, I think I have said enough to show that our Medal on this occasion has been worthily bestowed; and I trust I have not wearied you in dilating, possibly too long, on what has been to myself a very genial theme.

EWAN CHRISTIAN.

XI. REPLY TO MR. FERGUSSON'S PAPER * ON THE TEMPLE OF DIANA AT EPHESUS. By J. T. Wood, F.S.A., *Hon. Fellow.*

[Read on Monday, 9th June 1884, Ewan Christian, *President*, in the Chair.]

MR. FERGUSSON has published in our TRANSACTIONS his restoration of the Temple of Diana at Ephesus, making use of some of the data which I acquired by excavations on the site. His restoration differs so materially from my own, that I have thought it my duty to put before the Institute my own plan [Illustn. xliv.], in order that the members may fairly judge which restoration is most probable, and most in accordance with what has been written about the temple, and with ascertained facts which cannot be put aside to accommodate ideas irreconcileable with them. There are many important points on which Mr. Fergusson and myself are at variance. I regret this very much, for many an interesting conversation on this subject have we had within the last sixteen years, and although I come forward this evening to dispute his theory, I can honestly say that it is not with any spirit of ill-natured antagonism that I do so.

It must not be supposed for a moment that I set to work in the year 1863 in search of this long-lost temple, without having first studied all that is extant concerning it—it was in fact, in a great measure, the study of such morsels of information as a few ancient writers have furnished us with that excited my curiosity, and inspired me with an uncontrollable desire to find, and open up to the light of day, the hidden mysteries of the glorious building which was so vaguely described, but was nevertheless designated as one of the seven wonders of the world. One of the most notable of ancient writers who describes the temple is Pliny. It seems strange that Mr. Fergusson should place such implicit confidence in all that this historian wrote on this subject, although it is well known that his Natural History was compiled to a great extent from the writings of others, and from hearsay, and it is so easy to make mistakes in the measurements of buildings, as I shall prove by a remarkable instance; and as, in the case of the temple, as Mr. Fergusson remarks, Pliny never saw it, and therefore the dimensions he gives must have been copied from the statements of others, I think we must reject any of his dimensions which we cannot possibly reconcile with the data acquired by excavations.

The dimension given by Pliny for the width of what he terms the "universum templum," or the platform upon which the temple was raised, must be rejected for this reason; the actual width, measured on the lowest step, is 239 feet 4½ inches [Illustn. xliv.] Philo tells us that the temple was raised upon a platform of ten steps: the lowest step, more than 100 feet of which were found *in situ*, was 1 foot 10 inches in width [Illustn. xliii., fig. 161]; the two flights would therefore require 33 feet, thus leaving 206 feet 4½ inches or little more than 203 Greek

* See the TRANSACTIONS, 1882-83, page 147. Mr. Fergusson's plan forms Illustration lxii. in that volume.

feet, and not 220 feet as Pliny states. For the length of the platform I found nothing at the west end of the excavations to prevent our extending it for 425 Greek feet; by doing this I obtain ample space for one or more altars, as well as for large assemblages, and the marshalling of processions, such as that described in the interesting inscription found in the Great Theatre, and I would submit that this spacious area in front of the temple very much ennobles it. Mr. Fergusson suggests an arrangement of the steps in broad and narrow flights, which I think is inadmissible as a matter of taste, and those at the flanks and at the east end are impracticable, as they do not work in with ascertained data. The foundations on the flanks limit us to 21 feet from the front of the lowest step to the inner face of the masonry, and the 11 feet length of step at the east end [Illustn. xlii.] cannot be ignored as a limit in that direction. The steps of the platform did not, I believe, overlap, but the front of the riser of each of the upper steps was flush with the back of the step immediately below it; the bed of each step was sunk 1½ inch below the tread of the step below it. This I had an opportunity of observing during my recent excavations at a time when the water stood unusually low,—the foundations I should add being generally under water [Illustn. xliii, fig. 163].

The height from the pavement at the foot of the steps to the underside of the square plinth of the outer column is 9 feet 5½ inches. To mount up to this level, I have adopted the ten steps of Philo of fully 8 inches each, and three steps of 11 inches each next the outer columns; this makes the temple complete with its ordinary three steps [fig. 161]. I ascertained that the inner columns had no square plinth. I found a few inches of the front of the step which was here substituted for the plinth, and which proved beyond doubt that the inner columns were of the same diameter as the outer ones; the step under the base was also in two pieces [fig. 162], proving that it was part of a step and not a plinth, and therefore that the inner columns had no square plinths. I must here observe that I found in the foundation-pier of the inner column an additional proof that the earliest of the three temples, of which distinct remains were found, was of the same size, for here I found the plinth and the lower part of a base *in situ*, forming part of the foundation-pier of the last temple [fig. 167].

The earliest of these three temples was probably that which was commenced towards the middle of the sixth century, B.C., under the architects Chersiphron and his son Metagenes, and to which Crœsus so largely contributed. This temple appears also to have been adorned with sculptured columns, as fragments of archaic bas-relief, attached to a rounded surface, were found on the site, and may now be seen in the Archaic room at the British Museum.*

The second temple was commenced in the early part of the 4th century, B.C., by the architect Pœionius.

The last temple was commenced in the time of Alexander the Great, and must have far advanced towards completion when he came to Ephesus, as he proposed that he should be allowed to dedicate the temple to Artemis in his own name. According to my own restoration of this last temple, it measured 163 feet 9½ inches in width and 342 feet 6½ inches in length. Mr. Fergusson accepts the former measurement, but exceeds the latter by nearly 70 feet.

The instance of mistake in measurements of building to which I referred is to be found in Mr. Falkener's book, entitled *Ephesus and the Temple of Diana;* he there states that the

* A large lion's head, and some other fragments of archaic sculpture, found in some foundation-piers of a late period, must have come from the earliest of these three temples.—J.T.W.

diameter of the Great Theatre is 660 feet, and from that calculates that it would hold 56,700 people, a dimension which, I believe, he obtained from some notes by Professor Donaldson, who visited Ephesus more than sixty years ago. Whether Professor Donaldson's first figure was a 4, and was mistaken by Mr. Falkener for a 6, as it may be so easily, I do not know, but his calculation of the capacity of the theatre from this dimension is greatly in excess of the truth. The theatre is in fact only 495 feet in diameter, and would seat 24,500 people. I do not here impute any blame to either Professor Donaldson or Mr. Falkener, who, as we all know, would be most exact in publishing from their own notes, but the example I have given shows how easily a mistake may creep in when transcribing notes made by others.

To return to my restoration of the temple, I have ventured to place two altars [Illustn. xliv., at A, A.] on the platform at the west end—one for the sacrifice of animals, the other for offerings, such as the fruits of the earth, &c.

The absence of positive information as to the ancient cult of Artemis makes it difficult, if not impossible, to restore with certainty the plan of her temple from the remains found on the site, but it will interest my present audience to hear what Professor Paley, one of our most accomplished classical scholars, has to say upon this subject.

Artemis or Diana was the moon-goddess, and, as in sun-worship, human victims were offered in remote times, as part of the rite, so Agamemnon was persuaded to sacrifice Iphigenia to appease Artemis. In later times a symbolic blood-offering was paid to Diana of Aricia, by touching her altar from the blood of a pricked finger, as Martial seems to say. As Diana brings into light, as the goddess of light (Lucina), she was thought to rejoice in blood, but it may be doubted if the more savage superstition lasted, as at Mexico, to more civilized times. Professor Paley thinks that the great statue was hypæthral, because it was an object to let the moon shine directly on it, and that it would stand close to, and, as it were, preside over the principal altar.

As regards the plurality of altars, he thinks that, as the early church borrowed so much from Paganism, it might fairly be urged that the plurality of altars in churches, which dates from very early times, was taken from temple-worship; he thinks also that an altar might have stood in the court in front of the temple, as at Delphi, and that the πομπή or procession would as a matter of course go in by the main entrance, as now by the west door of a cathedral.

I gather from the valuable data with which Professor Paley has so kindly provided me that the sacrifice of animals was an essential part of the cult of the Ephesian Artemis, and that it continued as long as her temple at Ephesus stood, and that even human victims were offered in the times preceding the building of the earliest of the three temples of which remains have now been found.

The animal was slaughtered on an external altar, and morsels of the flesh were carried into the temple in a *patera*, and there put over fire; the smoke would then ascend from the altar, and make its way through the opening in the roof, and so propitiate the goddess, who was supposed to be hovering in the air over her renowned temple. Here again is one of several reasons why the *hypaithron* of Greek temples should be in the *cella* itself, and not, as proposed by Mr. Fergusson, in adjoining chambers. I have always imagined that the statue must have stood close behind the chief altar, and, as Professor Paley suggests, preside over it, and not 25 feet distant as Mr. Fergusson supposes.

In conversation with Mr. Fergusson on the subject of the *hypaithron* some time ago, I suggested that these openings in the roofs of temples admitted of the belief which was probably indulged in by the ancient Greeks, and other worshippers of mythic deities, that they floated in the air, and would at times descend into the temples dedicated to them. Mr. Fergusson's characteristic reply to this was, "Let them walk in at the door like other "people."

For the width of the temple itself, and the position of the columns, we have certain data; the bases of the outer and inner columns of the peristyle, the remains of the *cella* wall on the south side, the impression of the *cella* wall on the north side upon the rubble masonry of the foundation piers which were built against it, give us with certainty the dimensions *across* the temple, with the exception only of the two innermost columns of the peristyle. The dimensions longitudinally were ascertained by the impression of the extreme eastern wall on the rubble masonry, the bases of the columns *in situ*, the inner *cella* wall at the west end, and the foundations which inclosed the south *anta* at the west end — also several long dimensions taken between foundation walls. The intercolumniation of 17 feet 1¼ inches is derived from the measurement between the two bases of columns *in situ* which measured exactly 85 feet 6¼ inches, and this was checked by the dimension from the centre of the outer column on the south side to the centre of the last pier but two at the west end, as well as by a similar dimension on the north side. The intercolumniation of 19 feet 4 inches between the two external columns of the front was found repeated twice on the flanks by the dimension from the 2nd pier to the 3rd pier on the south side. I have not felt myself at liberty to make such a restoration of the temple as would tend better to satisfy the desire of those who imagine that groups of sculpture, bas-reliefs and statues, in addition to the sculptured columns and freize, were needed to account for the lavish admiration bestowed upon the temple by ancient writers. There are many modes of accomplishing this, but in introducing these features, we must I think carefully avoid detracting from the grandeur of the building. I have ventured, however, to put statues on pedestals against the walls of the *cella.*

One of the most important points of difference between Mr. Fergusson and myself is in respect of the number of external columns. Pliny in describing the temple makes it doubtful to the minds of many: the passage, "*columnæ centum viginti septem a singulis regibus factæ,*" may be read in more ways than one. I make Pliny's description agree with what was found, by putting a comma after the word *centum,* and thus I read that there were 100 columns, 27 given by kings. For this limited number only did I find places. It also appears probable that 27 columns would be about the number given by kings, and if there had been 127 columns, they could not *all* have been given by kings. Rich private individuals and communities would give some, and I happened to find part of the base of a column which was inscribed, showing that it had been given by a woman of Sardis.

Mr. Fergusson, however, reads the whole sentence* without a stop, and so infers that

* Mr. Thompson, of the British Museum, has suggested a reading of Pliny's text, which seems best to meet all objections to the sense in which I have understood him, viz., "Columnæ centum [viginti septem a singulis regibus factæ] LX pedum altitudine, ex iis XXXVI cœlatæ." By thus putting a portion of this description of the columns in parenthesis, the true meaning of Pliny's text becomes apparent, *i.e.* that there were 100 columns [27 given severally by kings] 60 feet in height, of which 36 were sculptured.—J.T.W.

there were 127 columns, the whole of which were the gifts of kings, and to accommodate this theory he lengthens out his temple to nearly 70 feet beyond its prescribed limits. Vitruvius describes the temple as octastyle, but if it had had three rows of nine columns in the *posticum* as suggested by Mr. Fergusson, he could hardly so designate it, and he would surely have made some allusion to so remarkable a feature.

The most interesting feature of the temple, and one that greatly accounts for its renown, must have been the sculptured columns—"*columnæ cœlatæ*" Pliny calls them—which were thirty-six in number; I have placed eighteen in the *pronaos* and eighteen in the *posticum*. I exhibit this evening two modes of treating these columns, one with only the lowermost drum sculptured, the other with three tiers of sculpture, separated by bands of mouldings. Some architectural critics, who are accounted people of taste, will not allow the probability of the latter arrangement, but where are we to place the drum, which is only 5 feet 7 inches in diameter, not 6 feet 0½ inch like the well-known drum? I do not despair of deciding this question by further discoveries on the site; for there may be many a beautiful example there still remaining to be unearthed.

I must here enter my protest against the proposal of Mr. Fergusson to adopt the two fragments, which I have suggested might have been parts of the frieze, as portions of pedestals for the sculptured columns. Mr. Fergusson was led into this belief by the marking of a large curve on the upper side of these blocks, which I think, myself, proved that they originally formed drums of columns of a more ancient temple; this curve approaches close to the edge of the blocks, which have only the bed-mould attached to them, and which could not therefore have been surmounted by columns. I need scarcely point out to the members of this Institute the incongruity of such a composition: some of the columns mounted upon pedestals, and some resting directly on the pavement.

The proportion of the columns is another important question relating to this remarkable building. I have based my restoration of the columns upon the statement of Vitruvius, who informs us that in the building of this temple the "improved Ionic order" was adopted, and that the columns were 8½ diameters in height, exclusive of the base; the columns were therefore 55 feet 8¾ inches in height, including the base and capital. The diminution of the columns was unusually excessive, being from 6 feet 0½ inch at the base to 4 feet 9 inches at the upper diameter.

The method of describing the volutes of the capitals is distinctly shown in one of the examples in the British Museum. The eye of the volute has not been cut out like the others, and the compass-points for turning the volute remain to show the method adopted, the radius diminishing in length as the eye of the volute is approached. The architrave consisted as usual of three *fasciæ*, but the fragments found have no bead-and-reel enrichment between the *fasciæ*, and the capping of the upper *fascia* is so hacked about that none of the mouldings or enrichments remain. If I am correct in supposing that the two angle-stones found at the west end of the temple formed part of the frieze, this part of the entablature was unusually high; part of the bed-mould of the cornice is worked upon these blocks, and nothing between this and the crowning *cymatium* has yet been found. The *cymatium* was 2 feet in height, and ornamented as usual with honeysuckle enrichment deeply cut, and with bold lions' heads as gurgoyles. Of the marble roof-covering many fragments were found, as well as one fragment

of an *imbrex* or *antifixa.* A large and beautiful fragment of an *acroterion* was also found at the extreme west end of the excavations, and it probably formed part of the central ornament to the apex of the pediment at that end.

The cost of the excavations made on the site of the temple was £12,000. not £16,000. as stated by Mr. Fergusson; the latter was the total amount spent at Ephesus by the government on *all* the excavations made there. I never refused, as Mr. Fergusson states, to give up my plans to the Trustees of the British Museum; I was never called upon to do so. It was always my intention to publish a folio book to illustrate the temple with all its details, as far as the discoveries might allow me, but the excavations were abruptly stopped in 1874, and I had not then found enough of the superstructure to make the Order complete; and many important features have not even yet been found, but I hope that further excavations will be carried on by subscription, which will enable me to add materially to the marbles in the Ephesian Gallery of the British Museum, and to publish a more complete book. Meanwhile I have published, for general information, all that was possible under the circumstances. I carried on excavations on the site of the temple during the spring of last year, and from September (1883) to last February, with the aid of private subscriptions, but the sum placed at my disposal only enabled me to explore a comparatively small portion of the ground that should be examined. Some additional fragments of sculpture and of the superstructure of the temple were found, but not any large portions of the sculptured frieze, which I expected to find, and which I still hope may be found by further excavations.

J. T. WOOD.

*** An abstract of this Paper was published, according to custom, in the Journal of PROCEEDINGS, issued on the Thursday following the meeting at which it was read. To that abstract Mr. Fergusson made a reply which was read the same evening and published in the same number of the Journal. See the PROCEEDINGS, 1883-84, page 167.

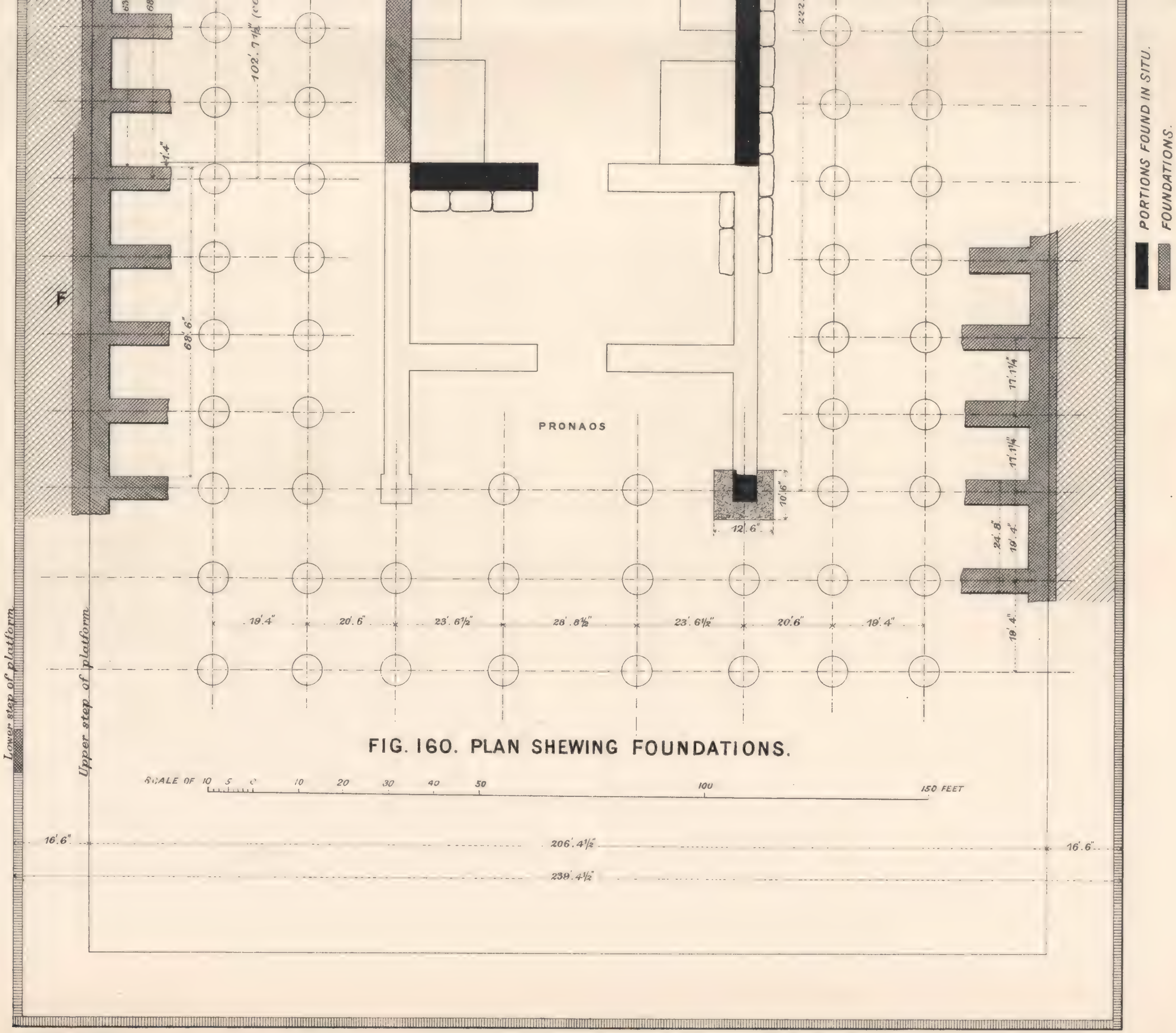
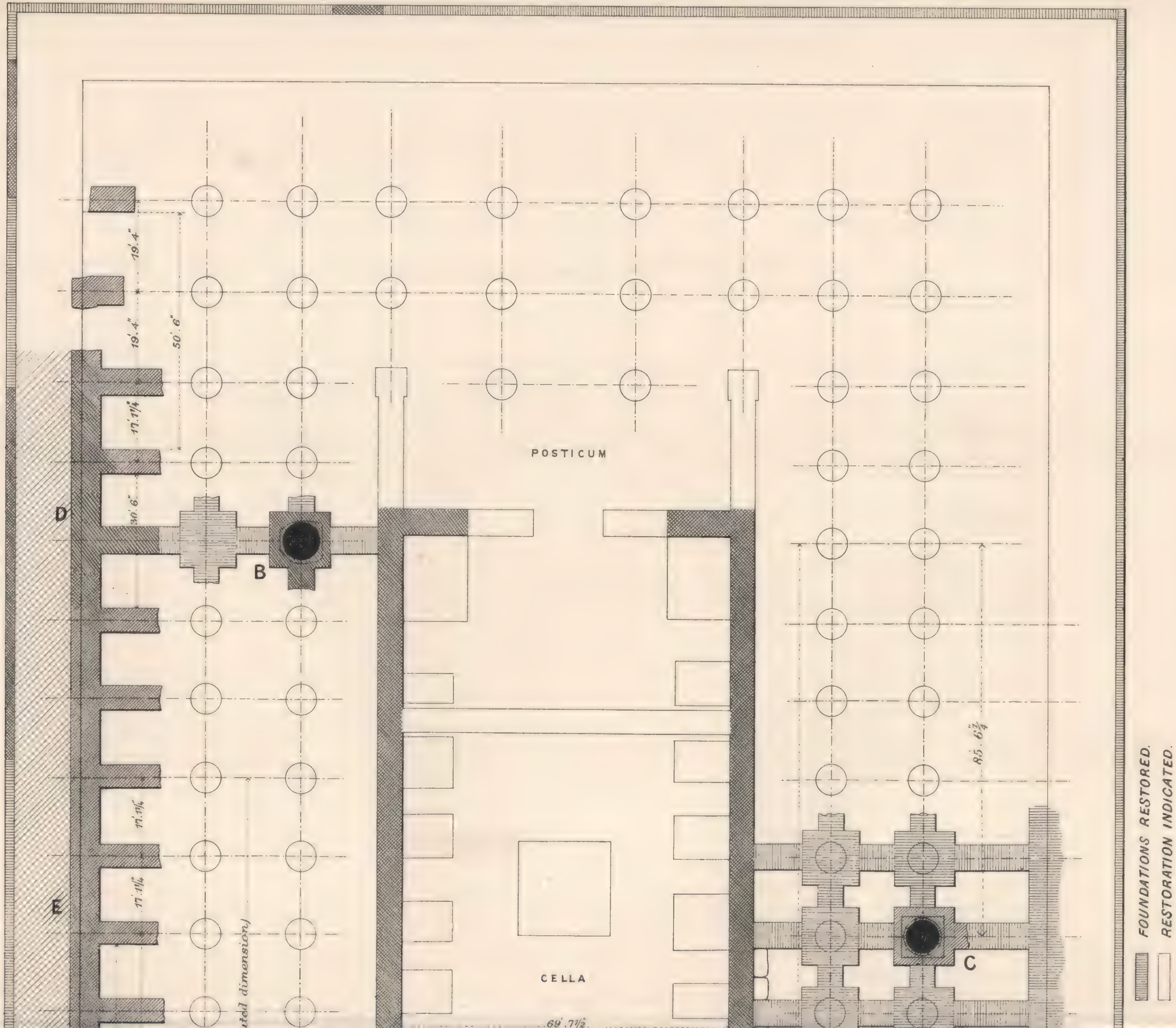


FIG. 160. PLAN SHEWING FOUNDATIONS.

J.T.Wood del.

C F.Kell.Lith 8.Castle St.Holborn.London.E.C

XI. REPLY TO MR FERGUSSON'S PAPER ON THE TEMPLE OF DIANA AT EPHESUS (xlii.)



XI. REPLY TO MR FERGUSSON'S PAPER ON THE TEMPLE OF DIANA AT EPHESUS (xliii)

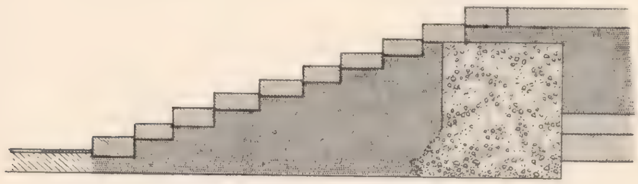


FIG. 164. SECTION AT D ON PLANS.

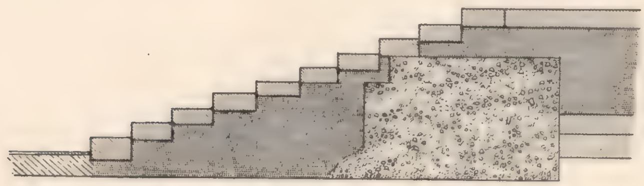


FIG. 165. SECTION AT E.

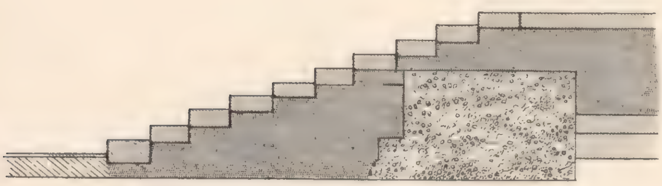


FIG. 166. SECTION AT F.

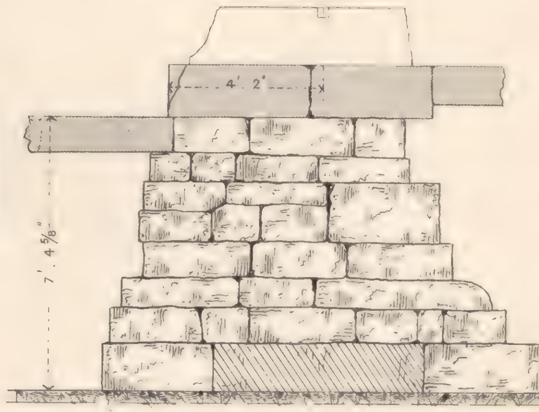
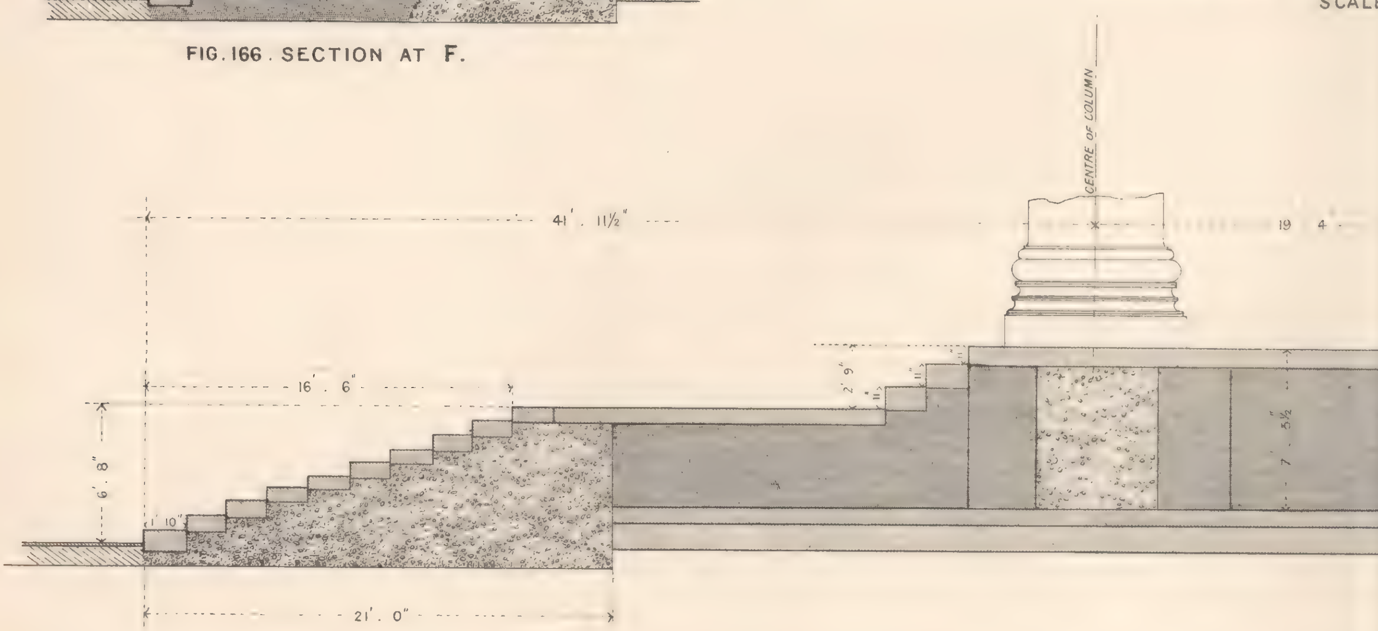


FIG. 162. FOUNDATION OF INNER COLUMN, B PERISTYLE.

F

SCALE OF 5 4 3 2 1 0

SCALE



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SCALE OF 5 4 3 2 1 0

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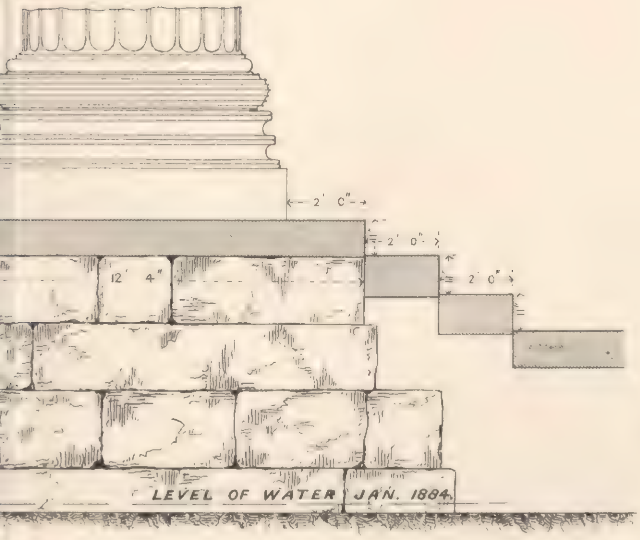
J. T. Wood del

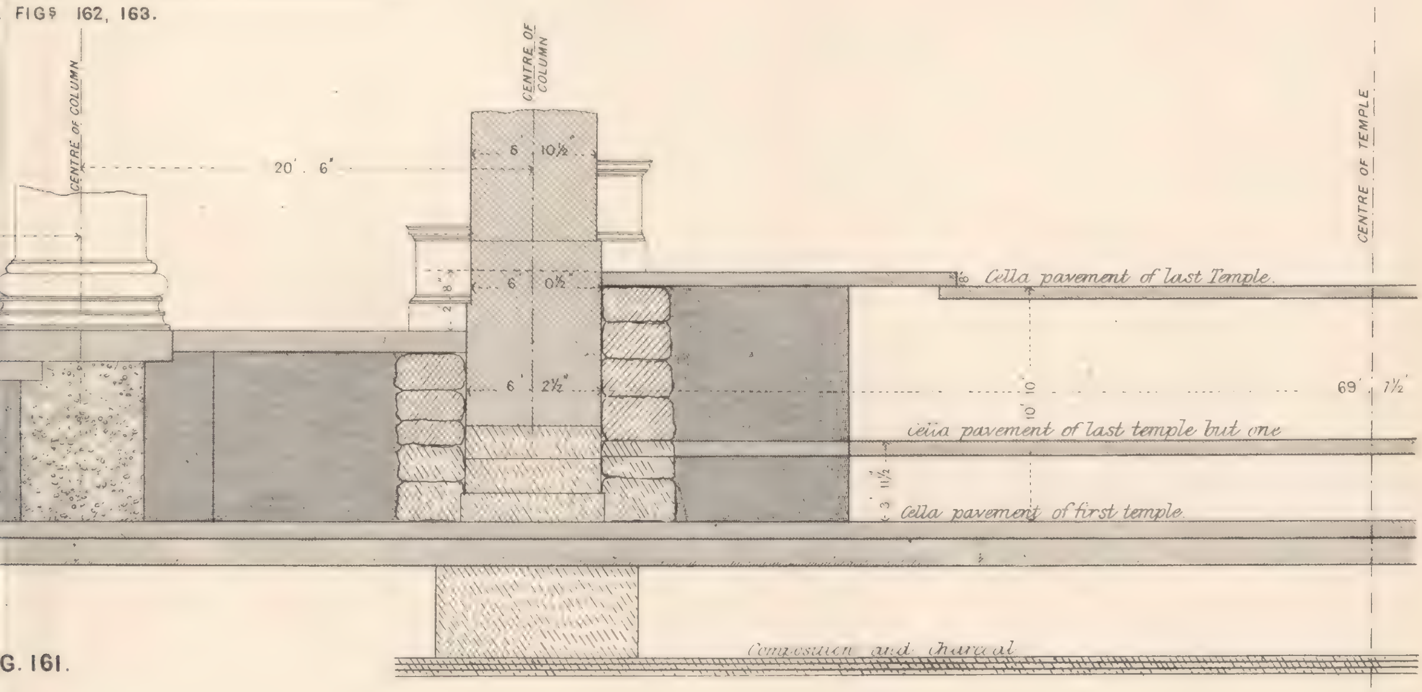


3. FOUNDATION OF OUTER COLUMN, C.
PERISTYLE.

5 10 15 FEET

FIGS 162, 163.

FIG. 167. SKETCH OF BASE AND FOUNDATION-PIER
OF INNER COLUMN, B.



G. 161.

RSE SECTION.

20 30 FEET

S 161, 164, 165, 166.

C. F. Kell, Lith 8, Castle St. Holborn, London, E.C.

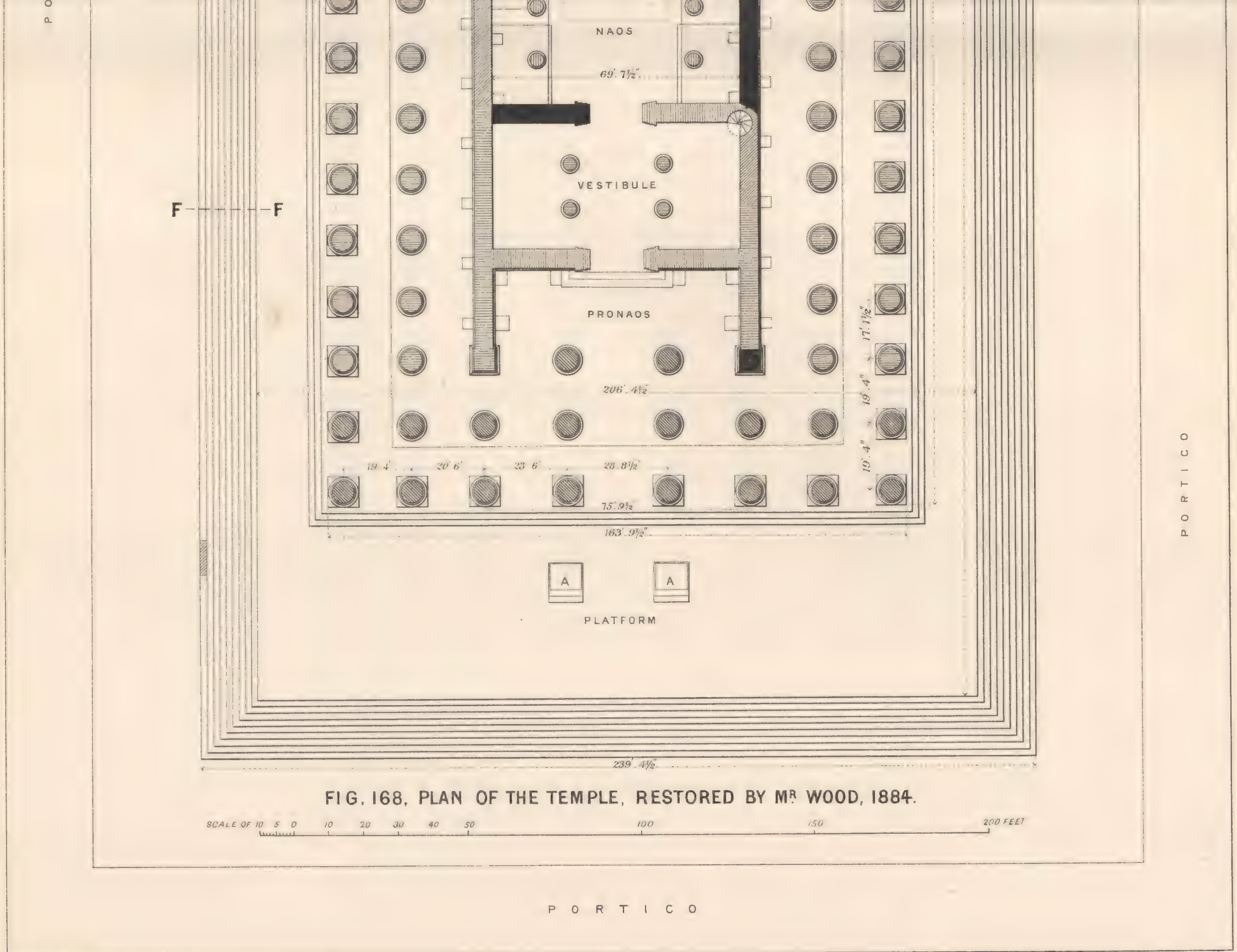


FIG. 168, PLAN OF THE TEMPLE, RESTORED BY MR WOOD, 1884.

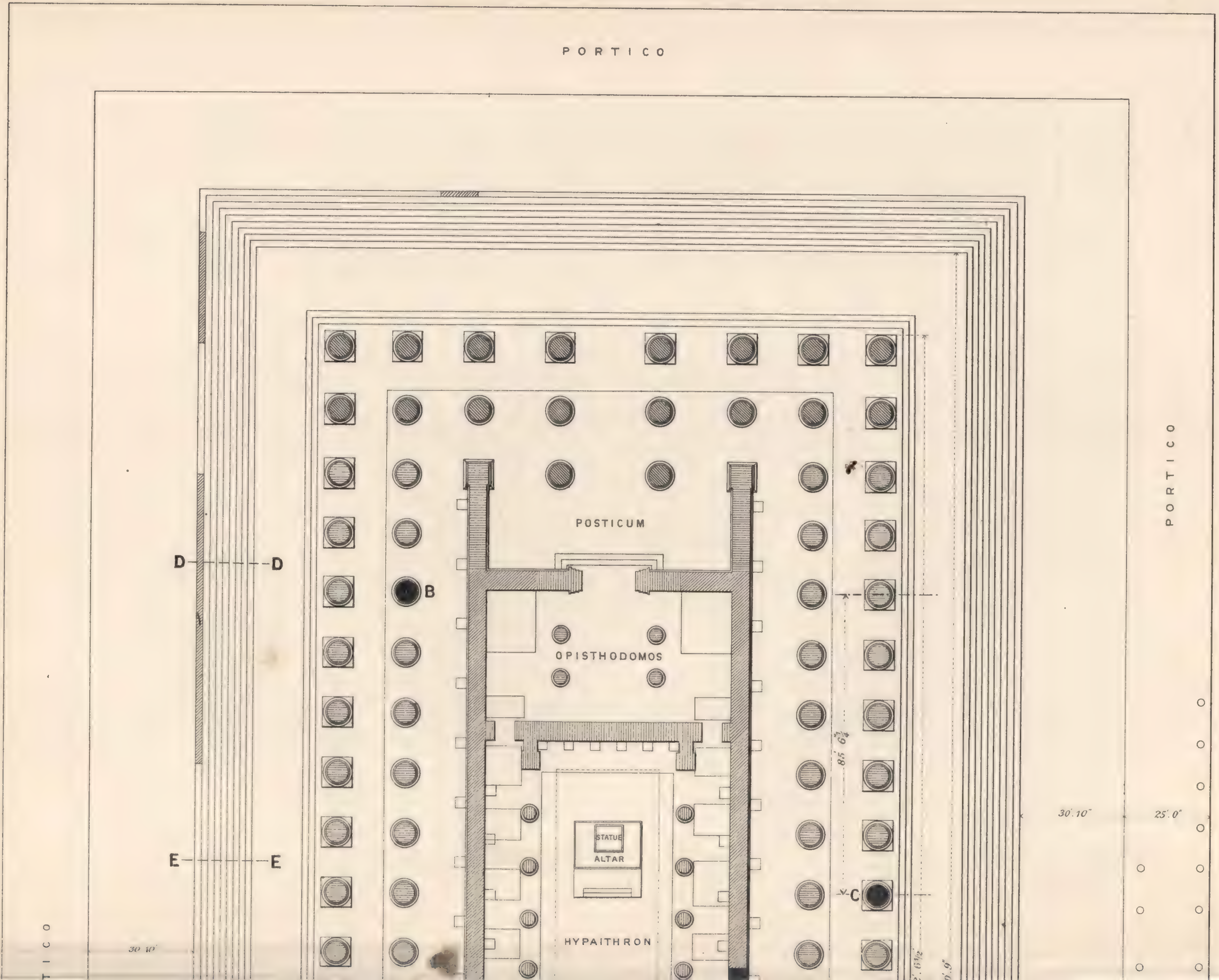
J. T. Wood del.

F. Kell Lith.

A.A. ALTARS. B.C. BASES OF COLUMNS FOUND IN SITU.

D.E.F. REFER TO THE SECTIONS ON ILLUSTN xliii, FIGS 164, 165, 166.

XI. REPLY TO MR FERGUSSON'S PAPER ON THE TEMPLE OF DIANA AT EPHESUS (xliv.)



XII. OBSERVATIONS ON THE PRECEDING PAPER ON THE TEMPLE OF DIANA AT EPHESUS. By James Fergusson, C.I.E., F.R.S., D.C.L. (Oxon.), *Past Vice-President.*

[Paper communicated and ordered to be printed, August 1884.]

ALTHOUGH I was not able to be present on the 9th of June when Mr. Wood's Paper was read to the Institute, I have since had the advantage of reading it deliberately "in slip." Having done so, I can only express my surprize that, as he has so very little to advance in favour of his restoration, and still less in opposition to mine, he did not adopt at once the views set forth in the Paper I submitted to the Institute on the 11th of June last year, and so end the controversy. I accept without dispute every fact he ascertained in his excavations, and I utilize every discovery he made—as far as he has yet made them public—to as great an extent as he has done himself. We only differ in this, that I have been able to reconcile them wtih every fact and every indication contained in the works of the Ancients, which he has not, and have in so doing produced a restoration much more worthy of the admiration it excited when entire, or of the eleven years of labour he bestowed on the very scanty remains that are now left for us to exercise our ingenuity upon.*

As in his Paper Mr. Wood takes no notice of my criticisms on the constructive details of his restoration, I presume he has no answer to make, and I need not therefore repeat them. They are more obvious from the larger scale of the plans attached to this Paper than in that previously published, and to me appear fatal, but as he and others may not think so, I pass them over, and will confine my present remarks to the three points which interest the public most, and which all can understand without any technical knowledge.

The first is, the number of columns. There is nothing so clear and certain in Pliny as

* As I should be very sorry to lay myself open to the accusation of misrepresenting Mr. Wood, even unintentionally, I may here explain that I quoted the £16,000., which his excavations cost the Trustees of the British Museum, literally from his book (p. viii.), without any attempt to discriminate between what was spent on the temple, and how much was laid out on the theatre and other explorations. I did so because I assumed that if the Trustees undertook to publish his discoveries, they certainly would have included at least his excavations of the theatre, which are nearly as important as those of the temple itself. Till Mr. Wood measured it, it had been reputed as by far the largest in existence. On the faith of some measurements furnished by the late Professor Cockerell to Colonel Leake, and published by him in 1824 in his *Journal of a Tour in Asia Minor* (p. 328), it is there given as 660 feet externally, with an interior diameter of 240 feet, and is so quoted by Falkener from this work, as mentioned by Mr. Wood. The curious part of the business is that, both in his plan of the city and that in which he represents its public buildings to a larger scale, he represents it with these dimensions as exactly as can be ascertained from the attached scales. Professor Donaldson never published anything on the subject, so far as I can make out, and it was left for Mr. Wood to ascertain its true dimensions. According to his plan (page 68) the external diameter was 474 feet, as figured on his plan, the internal 110, a fact the knowledge of which is an immense gain to the history of Greek theatres, and there are other facts ascertained by his excavations and surveys which would be of great value if given to the public, though not perhaps of such surpassing interest as those connected with the temple itself.—J. F.

his assertion that the number was 127, but so long as it seemed impossible to reconcile the existence of that number with the known principles of Greek architecture, it was allowable to insert commas and brackets, or use any expedient to explain what seemed to have been a mistake or a misconception. When, however, it dawned on me that thrice nine made 27, and I came to protract that number plus 100, regarding which there was no difficulty, on the ground plan as revealed by Mr. Wood's discoveries, the problem was solved, and as explained in my Paper there was no further difficulty. That the number was great and the arrangement unusual is clear from the fact, that this is the only great temple regarding which Pliny, as far as I recollect, or any ancient author, mentions the number of the columns as a whole; but to contend that he could not ascertain this fact without going there himself, and counting them, seems to me one of the most untenable arguments that could well be advanced. At the end of the thirty-sixth book, in which the description of the temple occurs, he quotes thirty-four authors from whose works the statements in that book were derived. Among them is Vitruvius, who mentions (præf. vii.) the description that Chersiphron and Metagenes, the architects, left of its peculiarities, and Mutianus the Consul, who wrote a book on the image of Diana in this temple, and Democritus the Ephesian who wrote, as we know from Athenæus, a description of the temple. If from these and the other authors he quotes he could not ascertain so obvious but at the same time so remarkable a fact, he showed less intelligence and less knowledge than in any other part of his works.

It is inconceivable to me why Mr. Wood should persist in representing the Temple of Ephesus as the smallest of the six great temples of the Greeks,* when a reasonable escape from the dilemma is afforded him. His contention is in direct contradiction to the express testimony of Pliny and Pausanias and the universal voice of all antiquity, which proclaimed this as the largest and most magnificent temple erected by the Greeks. Mr. Wood can claim for its magnificence only the thirty-six sculptured columns to compensate for such small dimensions. If the temple had only this merit we should probably have never heard its name mentioned, instead of its being reputed one of the wonders of the world.

The second point which seems of sufficient interest to be alluded to, is the appropriation of the four or five blocks, now in the British Museum, which are sculptured on two contiguous faces. Mr. Wood contends that these are the angle blocks of the frieze of the temple. If there are five that is of course impossible. If there are only four it is extremely unlikely that they alone should be preserved while not a vestige of the intermediate blocks remain. It would simplify the question considerably if Mr. Wood would let us know where these blocks were found. If they are the angle blocks they ought to have been found near the corners, but as far as can be made out from his "Popular Account" this was not the case, so the question must be argued on other grounds. My belief is that they formed portions of the square bases on which certain of the "columnæ celatæ" were mounted. In his excavations Mr. Wood found one sculptured drum of so much smaller diameter than the others, that, to meet the shaft of the column at the required height, he placed three sculptured drums one above the other to effect this, by what, I think, a most inartistic expedient. I propose effecting the same object by mounting them on square pedestals, which was frequently done in after times with great beauty of effect. But we are not left to opinions on matters of taste to decide this

* See the TRANSACTIONS, 1876-77, p. 86.

question. One of the slabs (that represented by Mr. Wood opposite his page 214) has a figure in high relief, alongside of it an ogee moulding of great beauty. If this were a part of the frieze, this ogee forms the bed-mould of the cornice, and if it did so, the whole head and neck of the figure projected above the cornice, which, I need not say, was impossible, but as part of a pedestal was unobjectionable. Besides this, on two others of the slabs, there are distinct weather-marks showing that a circular column once stood on them. Mr. Wood explains this by supposing that the blocks formed parts of some previous temple, and were only re-used in this one. This is not impossible, but a more improbable supposition could hardly be suggested, and might be considered if other circumstances demanded it, but all the evidence hitherto brought forward points the other way.

The third point of interest is the arrangement of the *podium*, which, as far as it goes, is an immense improvement, in an architectural point of view, from that proposed previously by Mr. Wood, but still very far indeed from what I conceive it ought to be. In an archæological point of view it seems to me it would not bear a moment's investigation. The principal reason that has induced Mr. Wood to adopt this alteration is apparently a passage in Philo's work *de septem Miraculis Mundi*, which says that the temple was raised on a pyramid of ten steps. This, however, as Mr. Wood admits, is obviously incorrect, as it required fourteen steps to reach the level of the floor of the temple. According to my reading of the passage, the pyramid commenced from the extended floor of the first temple. This had the advantage of reconciling both Pliny's measurements for the length and breadth of the temple—425 Greek feet by 220—with Philo's 10 steps, besides giving meaning to Pliny's description of the "Universum Templum," and in fact brought the whole into harmony not only with these two authors but with the level of the floors as ascertained by Mr. Wood. As he reads it he stretches the length of his platform to an unwarranted and most inartistic extent to accommodate it to Pliny's measurement of length, but fails entirely to reconcile it with his dimension for breadth, which it is fair to assume was as certain as the other, and if he were right in the one he could not be mistaken in the other. But what in his place I would consider as even more important, his *podium* does not agree with the level of any of the floors of the three temples as he ascertained them in his excavations, and he is obliged to use steps of different height and dimensions, for which he has absolutely no authority, to make them agree in even an approximative degree. Besides these mechanical difficulties the artistic considerations appear to me more than sufficient to decide the question in favour of the restoration I proposed.

This is not the place to enter on a discussion of how light was introduced into Greek temples. I have already said what I wanted to say on this subject in Papers in our Transactions,* and in my work on the Parthenon,† of which Mr. Wood takes no notice. His views on the subject are of the crudest possible kind. He adopts the absurd and I hope now exploded notion that the Greeks were so utterly devoid of skill or art that they could only roof their temples by omitting the roof altogether, and had no other means but this of admitting light. Whatever may have been the case with other temples, however, it certainly was not the case with this one. Strabo's indignant refutation of the accusation that the

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* November 1861, and January 1877. See the Transactions, 1861-62, p. 17; and 1876-77, p. 77.

† *The Parthenon: an Essay on the mode in which light was introduced into Greek and Roman Temples.* 4o. Lond. 1883.

Persian treasure was improperly used for the restoration of the temple is in itself almost sufficient to settle the question. "There could have been no Persian treasure in the temple," he says (bib. x, p. 641) "because after the roof was burned off would any sane person have "deposited a treasure in a temple without a roof ?"—*ἐν "ὑπαίθρῳ τῷ σηκῷ*. Besides this we have the distinct testimony of Vitruvius (book II, ch. 9) that it had a roof formed of cedar-wood; and Pliny even more distinct (XXVI, 40), that the roof was constructed with "trabibus cedrinis;" so that some other mode of introducing light must be had recourse to. There is probably no temple in antiquity in which this was so easily done. According to the account of the image quoted by Pliny from the Consul Mutianus, it must have been a mere *simulacrum** of the most archaic form, and probably hardly life-size, so that the mode of lighting it must have been of the least possible consequence. All that was required in this case was that sufficient light should be introduced to enable the pictures and other adornments of the temple to be seen to advantage, without the least reference to the artistic mode in which this was introduced.

No one doubts the learning of Professor Paley, but before any one accepts his dicta regarding this particular temple one would like very much to know in what form the case was presented to him on which he gave the opinions Mr. Wood quotes with such unction. So far as I can gather from the context his account of the worship of Artemis may be most valuable, but has no especial reference to the Ephesian temple, which is the only one with whose peculiarities we are at present concerned.

I have now gone several times over the evidence on which my restoration of the Temple of Diana at Ephesus is based—the last time with the benefit of Mr. Wood's detailed criticism upon it. Having done so, with, I hope, every intention to admit any fair or valid objection that can be made to it, I feel convinced, in the first place, that Mr. Wood's discoveries—even so far as they have been published—are quite sufficient to admit a restoration of the temple being made which shall be correct in all essential particulars, and in the next that the one I have proposed represents both the plan and the elevation with as much truthfulness as is attainable under the circumstances. When further details are published there may be some minor points which may require rectification, but my impression is that nothing can now be brought to light which will cause any modification in any essential parts of the design.

JAS. FERGUSSON.

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* Where Mr. Wood discovered that I placed the image 25 feet behind the chief altar I am at a loss to conceive: I am not aware that I ever expressed any opinion on the subject.—J. F.

XIII. THE DUTIES, OBLIGATIONS AND MUTUAL RELATIONS OF ARCHITECT, CLIENT AND CONTRACTOR, WITH REFERENCE TO ENGLISH AND FOREIGN PRACTICE.

By ARTHUR CATES, *Member of Council.*

[Read* on Tuesday, 6th May 1884, Charles Barry, F.S.A., *Past President,* in the Chair.]

WHEN drawing up the programme of the proceedings of the General Conference (1884) of Architects, the Committee considered that "the duties, obligations, "and mutual relations of architect, client and contractor, with reference to both "English and foreign practice," would form an excellent subject for discussion at one of the meetings. They accordingly prepared a series of questions which were addressed to correspondents of the Institute, with the result that replies have been received from Professor Fenger of Copenhagen, Theophilos Ritter von Hansen of Vienna, and Herr Ende of Berlin.

Communications respecting the practice in America have also been received from Mr. Sydney Smirke, who practised for many years in America. For France I am indebted for much information to Mr. William H. White and Mr. R. Phené Spiers, and I have referred to some of the leading text-books on French Building Legislation, more particularly to,—

Manuel des Lois du Bâtiment, published by the Société Centrale des Architectes.

Frémy Ligneville, *Traité de la Législation des Bâtiments,* 2 vols. 8vo. 1881.

O. Masselin, *Nouvelle Jurisprudence et Traité pratique sur les Honoraires des Architectes,* 8vo. Paris, 1879.

O. Masselin, *Nouvelle Jurisprudence et Traité sur la Responsabilité des Architectes,* etc., 8vo. 1879.

I must admit that, when the questions settled by the Committee were first placed in my hands, I was somewhat startled by the wide range they covered, which seemed to me likely to require a whole conference or even a series of conferences for their complete discussion. As, however, the time at our disposal this evening is but limited, I will, as shortly as possible, bring before you the replies which have been received.

1. Happily, the first question,† which relates to the tenure of land for building purposes, has been thought to be of sufficient importance to have an entire meeting appropriated to its consideration, and Mr. Blashill will read a paper thereon.

The next series of questions relates to the architect, and it will be convenient to consider each separately. Thus :—

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* At the second Meeting of the General Conference of Architects held in London from the 5th to the 9th May 1884.

† This question was thus worded—(*a*) When a person desires to build a house, does he usually obtain freehold land, that is to say, land of his own? or (*b*) does he take a long lease? or (*c*) a lease in perpetuity? and (*d*) on what terms? Mr. Blashill's Paper on the tenure of land for building purposes is at page 190.

2. When an architect is employed upon the erection of a house, is it usual for him to perform the following services?—(*a.*) Preparing all the drawings that are required and a specification of the works; (*b.*) Arranging terms with the contractor or contractors; (*c.*) Superintending the work; (*d.*) Deciding on the amount of money that is to be paid to the contractor or contractors according to the terms and dates of payment.

To this, the reply from Copenhagen is the simple affirmative,—Yes; but in Austria the architect's duties appear to be somewhat more extended, as beyond those set out in the question he prepares an accurate estimate of quantities of the building to be executed, from which the contractors can ascertain the quantities of the several descriptions of work.

A similar practice appears to exist in Germany, and in France the preparation of the *devis estimatif* is one of the duties of the architect, and it is included in the services covered by his commission; but on this head more particulars will be given when the tariff of charges under which German architects' work and the remuneration of French architects is considered.

3. To the third question,—Does the architect usually perform any other services?—the reply is in each case, No.

4. Is his decision as to the quality of the work and material and as to payments final and binding?—is answered, in accordance with ordinary English practice, with the proviso, as regards Austria, that, if the contractor desires in such cases to appeal to a legal tribunal, the right of doing so must be expressly stipulated in the contract; while in Germany it is often stipulated in the contract that in cases of dispute one or more arbitrators shall decide the question at issue.

5. Is the architect responsible to the client for any losses that may arise through bad work or materials which he ought to have checked; and, if so, for a limited or unlimited time?

It appears that in Denmark this responsibility has not hitherto been exactly defined by law or by custom, but if losses have been suffered through the architect's neglect or liability the employer may sue him for damages within the first twenty years.

The reply from Vienna is vague, and to the effect that the contractor is held responsible for, and to make good, loss through bad work or bad material.

The Architectural Society of Germany has the responsibility of the architect to the client at present under consideration, but no decision has been arrived at. There the tradesman is responsible to the architect as well as to the client for the goodness of the work. In doubtful cases the architect leaves the selection of the tradesman to the client, thus giving the latter an influence by which he cleverly diminishes his own responsibility. No instance is known to Herr Ende in which an architect has had to bear the responsibility for the shortcomings of a tradesman. Every architect is legally answerable for his designs so long as these are followed. Where a tradesman deviates from the instructions of the architect the latter assumes the responsibility if he sanctions deviations in a general way. If the architect is demonstrably lax in his supervision, of course the law holds him responsible.

In France and those countries subject to the *Code Napoléon* the responsibility of architects and contractors is defined by six articles of the *Code Civil,* four of which are of general application, while Art. 1, 792,—" Si l'édifice construit à prix fait périt en tout ou en partie par le vice de la contruction, même par le vice du sol, les architecte et entrepreneur en

sont responsables pendant dix ans,"—appears to make the architect and contractor liable for ten years; and Art. 2,270,—"Après dix ans, l'architecte et les entrepreneurs sont déchargés de la garantie des gros ouvrages qu'ils ont faits ou dirigés,"—relieves the architect and contractor from liability after ten years.

There has been considerable controversy as to the exact meaning of Art. 1,792, it being contended that it is only applicable where the architect is the contractor; but, nevertheless, the responsibility attaches to the architect under the general principles of Art. 1,382:—"Tout fait quelconque de l'homme, qui cause à autrui un dommage, oblige celui par la faute "duquel il est arrivé à réparer"; Art. 1,383:—"Chacun est responsable du dommage qu'il a "causé, non seulement par son fait, mais encore par sa négligence ou par son imprudence"; and Art. 1,992:—"Le mandataire répond non seulement du dol, mais encore des fautes qu'il "commet dans sa gestion," which make him, in common with all other citizens, liable for the results of faults he may commit, and those he may by negligence or otherwise permit others to commit over whom he may have authority. For errors of design and want of skill resulting in failure of the building wholly or in part, neglect of legislative enactments and municipal and police regulations, neglect of servitudes and easements to which the site is subject and which the architect could have ascertained, providing a building which does not satisfy the defined requirements, the client has his remedy against the architect alone. For improper execution of work, defective or improper material or workmanship, the client's remedy is against both contractor and architect: against the one for having committed the wrong, and against the other for having by inefficient superintendence permitted it; but the architect himself has his remedy against the contractor. These responsibilities have many qualifications arising from the varying relations of the parties, but it would not be possible to enter into such details on this occasion.

The limit of ten years does not apply to cases of fraud: in these the term of prescription is extended to thirty years.

In England the Statute of Limitations being seven years, it would appear that the architect is, in ordinary circumstances, protected after the lapse of that period.

6. On what basis is the architect's remuneration calculated, and is this settled by any law or custom?

The Danish architects have not yet agreed upon a schedule of remuneration, but often use the German and Swedish schedules, which will be found in the report* of the Congrès International des Architectes, Paris, 1878.

In Austria the terms of professional remuneration are not fixed by law, but the Society of Engineers and Architects, of Vienna, has drawn up a certain scale of charges. It is, however, optional with the architect and client whether they accept this or not. As a rule professional remuneration is calculated at from three to five per cent., according to the nature of the work.

In Germany a very elaborate tariff is adopted which was drawn up by the Architectural Section at the Fifteenth Congress of German Architects and Engineers, held at Hamburg in 1868. The ordinary work of the architect is there divided in five classes, commencing with

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* *Congrès International des Architectes tenu à Paris, du* 29 *Juillet au* 3 *Août* 1878. Paris, Imprimerie nationale, 1881. See pages 128 and 140.

ordinary agricultural buildings and the plainest description of town and country dwellings, and ending with exterior and interior decorations and ornamental work. The scale of remuneration is set out under six subdivisions of the architect's work and nine progressive stages of cost, the first limit being £300., and the highest £30,000., and upwards.

The services to be performed by the architect are defined as [see table, page 189]:—

(*a.*) *Sketches.*—Preparing sketches (plans and elevations) drawn to scale and (if desired) approximate summary estimate of cost.

(*b.*) *Design.*—Preparing complete design with plans, elevations and sections, together with a summary estimate of cost as for *a.*

(*c.*) *Working drawings and details.*—Preparing the requisite working drawings and the detail drawings of construction and decoration.

(*d.*) *Estimate of cost.*—Preparing a special estimate of cost of construction.

(*e.*) *Execution.*—Drawing up contracts for, and letting, and general superintendence of, the execution of the whole of the works, exclusive of special superintendence.

(*f.*) *Accounts, &c.*—Checking and certifying the accounts, exclusive of measuring up.

For works of smallest cost the rate per cent., for the entire services varies from five per cent. on the smallest expenditure for the lowest class of building to 9½ per cent. for a like expenditure on the highest class of building; while for works of greatest cost the rate of remuneration varies from 2 per cent. on the largest expenditure for simple buildings to 5 per cent. on those of the highest class.

Fees on rebuilding or additions to existing buildings where a special design is necessary are calculated at one-fourth more, and where a design is not necessary at one-fourth less, than for the same class of new work.

Advances on account during the work in proportion to the progress of the work and in accordance with the rules shall always be paid to the architect on demand.

If the estimate be exceeded such excess shall not increase the fee, but the cost of duly sanctioned extensions or more sumptuous treatment of the work shall increase it.

All drawings remain the property of the architect. The client may demand copies of the design, but shall use them only for the work to which they relate.

This German tariff has been adopted by the architects of Belgium, Switzerland and Italy; and has, I think, been printed at length in the London professional journals.

The remuneration of architects in Sweden is regulated by a system similar to that adopted in Germany; but, while the services to be rendered are similar to those there given the rates of percentage are somewhat less.

The services to be rendered by an architect in Sweden, are:—

Esquisse,—Dessin net, avec un devis approximatif.

Dessins et plans principaux.—Dessins complets.

Devis et descriptions,—Calcul des frais, avec indication des quantités et des prix, ainsi que désignation des matériaux, et du mode du travail.

Epures,—Tous les dessins de construction et d'ornementation.

Surveillance,—Stipulation de contrats d'entreprise et surveillance de l'exécution.

In France it has been decided by the Cour de Cassation, as recently as 1875, that no law or regulation exists which fixes the fees due to an architect for private work: that the Courts

should, in the absence of any agreement, regulate them with reference to the work carried out and the services rendered.

Public departments, such as the Ministère de l'Intérieur, des Travaux Publics, des Cultes, la Ville de Paris, &c., make special contracts, by which the architect, besides an annual salary (" *traitement fixe annuel* ") is entitled to a commission (" *traitement proportionnelle* ") on the cost of the work; and, after their completion, he might be granted a further payment (" *gratification* "), not so much as a pecuniary advantage, but as an expression of satisfaction for work executed with economy and skill.

Although the fees of architects have never been fixed by law, because the art is a liberal one, they are, when not otherwise agreed, generally determined by the custom of the place, or the scale fixed by the Conseil des Bâtiments Civils in 1800 and confirmed in 1841, by which the remuneration of architects employed by the Government was fixed at 5 per cent., the services to be rendered being defined thus :—

Confection des plans et devis dans les travaux ordinaires	$1\frac{1}{2}$ per cent.
Conduite des travaux	$1\frac{1}{2}$ per cent.
Vérification et règlement des mémoires . . .	2 per cent.

The whole question of " *honoraires* " was very fully discussed at the Congrès International des Architectes, held in Paris in 1878, and under the auspices of the Société Centrale des Architectes, and I would refer those who are desirous of more detailed information than can be here given, to the report of the proceedings of that Congress published in 1881 by the Ministère de l'Agriculture et du Commerce.*

The subject has occupied the attention of the Société Centrale des Architectes not less than that of this Institute. In 1849 a committee of the former body reported that 5 per cent. must be taken as a mean applicable to most cases; that it had been generally recognized by courts of justice, but by arrangement, by reason of the importance or otherwise of the services rendered, might be deviated from.

The following extracts from some of the communications made to it sufficiently explain the spirit with which the question was considered at that Congress :—

"Whatever the merit of the architect who conceives and executes; whatever the nature of the work; whatever the skill, care, and time devoted to the studies and to the superintendence,—always 5 per cent."

"The painter, the sculptor, obtain for their works their value; the physician, the counsel, charge their fees in accordance with their position and merits, and the care which they bestow. The counsel may have mistaken the case, and advised his client badly, but the latter pays his fees, and no more is said. The physician may have erred, his patient dies, and with him the doctor's mistake is buried; but nevertheless his fees are paid."

"The architect, however, receives always 5 per cent.; but if he makes a mistake, or is deceived, or if he has given way to concessions which may compromise his work, the critic is ready to seize with avidity on his faults, while justice is invoked against him with such rigour that even his future prospects may be affected, and that fortune and position to attain which the architect is ever struggling may be compromised."

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* See footnote page 177 *ante*.

"Pretended architects accept work on such terms that they cannot without loss perform the serious duties of the profession, but certainly if they thus lose they profit in other and less legitimate ways—the client who thinks he has made a good bargain is not aware that the architect may obtain from the contractors more than the difference he has saved, and to obtain it sacrifices his liberty of action, and hands himself over to them."

The late M. Davioud strongly urged the impossibility of framing an equitable tariff, the inapplicability of such a tariff system to an open and liberal profession, and the necessity of leaving each practitioner to assess his own value, and to make his own bargain in accordance therewith and the nature of the work to be undertaken. In the result, after very long discussion, the Congress arrived at resolutions to the following effect,—

"The Congress, acknowledging the principle of freedom of labour and its unfettered remuneration which is established on the principle of supply and demand, is of opinion that every architect should appraise his work at such value as he may think fit, which should be a fair remuneration for the skill displayed and the special difficulties overcome. Nevertheless, in the absence of any special agreement, it considers that the *Avis* of the Conseil des Bâtiments Civils should be applied as a minimum until such scale has been modified in an equitable manner."

Thus, the result of the Congress was that the inevitable 5 per cent. was considered to be a reasonable basis of remuneration.

Here, in this room, the architects of the United Kingdom have, at great length, and for the last time twelve years ago, discussed the same subject and arrived at a similar conclusion, but having printed a document setting forth the opinions of this Institute and that Conference, with reference to professional charges, it has been most unjustly imputed to the Institute that it partakes of the character of a trade union, an impression being somewhat general that adherence to the terms set forth in that document is an essential condition for membership of the Institute.

My own view of the position is this—that the document expresses the ordinary custom of the profession, by which, in the absence of any agreement to the contrary, the relations between architect and client should be governed; but the architect is left perfectly free to himself assess the value of his work. If the circumstances of the case and the nature of the work permit him honourably to accept a lower rate of remuneration he is perfectly at liberty to do so; while, on the other hand, if he considers that his position in the profession or the value or importance of the services rendered entitle him to make his charge at a higher rate, or as has been done by a late well-known and highly-respected member of this Institute, without regard to percentage at all, he is perfectly at liberty to do so, and to secure the highest remuneration he can obtain.

7. The seventh question, "Are there any other important matters affecting the architect in "his relations to his client or the contractor?" has not elicited any replies which need occupy your attention, but the ownership of the drawings is one which certainly merits the most careful consideration of the Conference, and may be considered under this head.

In France, Frémy Ligneville (vol. i., p. 229) declares the law to be that, in the absence of any agreement to the contrary, the fees paid to the architect are considered to be due, not only

for the construction of the building, but also for the preparation of the plans in accordance with which it has been erected. Thus the client can demand the delivery to him of these drawings, and the architect cannot claim any special fee for them; but the architect has the right to retain the plans and specifications he has prepared until his fees have been completely paid.

The sixteenth Article of the Institute document expresses the general custom that the drawings and specification remain the property of the architect, but recommends a distinct understanding with the client on this point.

The German architects,* in the remarks appended to the tariff before referred to, dispose of the question thus :—" All drawings remain the property of the architect. The client may " demand copies of the design, but shall use them only for the work to which they relate."

The third general head under which the questions were framed was that of " The " Contractor," and in considering the replies and statements which I shall have to put before you, it must be borne in mind that the circumstances under which buildings are executed are so variable, and dependent upon so many conditions, that the information given must be accepted as only of general application, and not as representing invariable practice.

8. The eighth question runs thus :—" Is it the custom to employ a general contractor to " execute all the works required to be done in a building, or is the contractor employed for " each trade, viz., a contractor for masonry, another for carpentry, another for ironwork," &c. ?

In Denmark both arrangements are usual. In Austria, in better class buildings, as a rule, separate tradesmen and contractors are usual for the several descriptions of work, as the master-mason or master-bricklayer, the stone-cutter, the master-carpenter, constructor of ironwork, plumber, &c.

In Germany both modes of letting work are practised. Where the client engages an architect he, as a rule, requires that the work of each trade be let separately. A great many architects, however, undertake the erection of buildings for a lump sum, especially in cases where the client wishes to be insured against extras, desires not to have to deal with so many parties, and prefers the sole and exclusive responsibility of the architect to that of a multitude of individuals.

In England it occasionally occurs that the builder provides the design and drawings for the work he carries out; in fact, it is rumoured that builders who so proceed have said, " Oh, we keep an architect, and you need not go to the expense of employing one "; but the architect who contracts to carry out his own design is in these days, I think, quite unknown. If the practice does exist it would be most desirable that, if possible, full information should be obtained respecting it.

In France the general practice is to employ separate tradesmen, an independent bargain being made with each; but the general contractor is not entirely unknown. The ordinary

* Ritter von Hansen, *Hon. Corr. Member*, writing from Vienna on the 5th May 1884, states—" As regards your question relating to the ownership of plans, it is customary here that all plans remain the property of the architect. In Vienna, however, in order to obtain permission to build, it is necessary to deposit two copies of the plans, one becoming the property of the City Building Department and the other the property of the owner of the building. In buildings of considerable extent, if the owner desires to have plans of the work as executed, these are made out, with special reference to internal fittings, gas- and water-pipes, &c., and ought properly to be specially paid for.

practice appears to be what was, I think, formerly universal in England, and is still retained in the north. Mr. R. Phené Spiers has communicated to me a letter from M. Pascal, a distinguished architect of Paris, in which he says on this subject:—

"Notwithstanding the advantage which may be derived from having one general "contractor, we prefer special tradesmen, who do their work better. The sole "difficulty for the architect is to make them work in harmony with each other, "without reciprocally causing delays or prejudice to other works. The general "contractor naturally takes a profit from each sub-contractor, hence augmentation of "cost. He cannot be competent in all the specialities which he represents. Hence "inferiority in the quality of the work: two causes which lead to the system of "division of the trades being preferred even to the extent that a general contractor "is only occasionally admitted for the works of the State."

There is a growing tendency in England towards employing special tradesmen for important sections of the work, but the great saving of trouble and annoyance, arising from the employment of the general contractor, renders it hardly likely that the good old system of master tradesmen contracting for each trade will be revived, and handicraft thus suffers.

9. "Is it usual for a tradesman or tradesmen to contract to do the building as shown by "the drawings and specification for a fixed sum to be paid to him or them by the employer?"

The reply to this question received from Berlin is so important, that I should have been glad to have had the opportunity of making further inquiry respecting it, but time has not permitted this, and I will therefore quote the words of Herr Ende:—

"Cases in which the erection of a building according to the designs and estimates of an "architect is let to a contractor who is not an architect are comparatively rare, "particularly as regards elaborate and ornamental buildings, though it is done in "the case of simple and ordinary ones, the reason being that, according to the idea "prevailing here, an artistic building can never be completely finished from the first "design and the first estimate, but the chief and best portion of the work must be "designed and worked out during its construction. There is, however, an end to "this when a contractor undertakes the building. Alterations can then be made "only under stringent and costly conditions, which give occasion to all kinds of "disputes."

The ordinary French system appears to be the *Marché au rabais* or *par série de prix.* Till recently the *Série de Prix de la Ville de Paris* was generally accepted as the basis, and each separate tradesman made his offer at a price to be calculated at a percentage above or below such schedule of prices. Recently the Société Centrale des Architectes has issued a *Série de prix*, and the authorities of the *départements* and the great cities have also engaged themselves on the preparation of similar schedules suitable to each locality.

The *Marché à prix fait* or *à forfait* is a contract for a lump sum, very similar to our ordinary contracts.

There is also another form of contract which removes the inconvenience, attending that *par série de prix*, of the client not knowing beforehand what the ultimate cost will be. This is known as the "*Marché de maximum*," and combines both the preceding systems, the

bargain being that the work is to be paid for in accordance with the *série de prix,* but with the reservation that the total cost shall not exceed a fixed sum.

10. The Committee then ask, "Is it usual to select a contractor by means of tender "received from several tradesmen stating the price at which they will do the work?"

In Austria the best method of selecting a contractor is thought to be by competition, either a limited one among trustworthy firms, in which case the contract must be given to the lowest tenderer; or an open one, in which case the contract is not necessarily given to the lowest tenderer; but to the most reliable one at the lowest possible prices.

11, 12 and 13. "Does a contractor make up his tender by means of measurements or "quantities taken from the drawings and specification? Are these measurements prepared by "the contractor or contractors for his or their own use, or by some other person for his use? "Who pays that person?"

I feel much hesitation in dealing with these questions, for they can only be satisfactorily answered after closer inquiry than it has been possible to make.

In Denmark the contractor makes his measurements for his own use. The Danes have no surveyors to take out quantities, and nothing is paid for them.

In Austria the amount due to the contractor is ascertained by measurement from the drawings of the work actually performed, and it is only as an exception that the measurements are taken from the work itself. The measurement and taking out of quantities are performed by the architect from the plans, but the contractor has to make out a measurement for the account.

In Germany estimates of quantities are prepared by the architect, or at least under his instructions by his permanently-employed assistants. There are some few persons who occupy themselves exclusively in the preparation of estimates; but the architect has in all cases to check their work and be responsible for it. The system of "*vérificateurs*" which obtains in Paris is quite unknown.

In France, the architect should provide besides the *devis descriptif,* or specification, the *devis estimatif,* or particulars of quantities, which documents, together with the general conditions, constitute the *Cahier des charges.* When a contractor tenders he employs a *métreur* to take out quantities. This *métreur* is often a clerk in the contractor's office, and is paid by him. The *mémoires* or bills are checked by the architect or by the *vérificateur* paid by him.

In Germany the architect is responsible for the estimate of quantities, but he endeavours to diminish his responsibility by submitting the calculations to the contractor for the purpose of being checked, and of conforming to his criticisms; that is, adopting the same reckoning.

The responsibility of the contractor to the employer for losses caused by bad work and materials is in France and in Germany limited, unless otherwise stipulated, to a period of ten years, and I commend to the student of this subject the treatise of M. Masselin to which I have before referred.

Generally each of the correspondents appear satisfied that the system in use in his own country works fairly well, Professor Fenger making the necessary reservations:—1. That only competent persons are employed as architects and contractors. 2. That the necessary time is granted for preparing plans, specifications and tenders, and for erecting the building. Generally reviewing the information which has been collected, it appears that the profession

in England occupies a position in many respects more advantageous than in other countries, and there is, I think, but little which could with advantage be adopted from foreign practice into our own.

There are two subjects of some interest which were not touched upon in the questions prepared by the Committee, or alluded to by their correspondents, with regard to which I beg leave to occupy your attention for a few minutes. These are known in France as *expertise* and *privilège*.

Expertise relates to the course taken in litigation to inform the court upon technical facts, the endeavour to ascertain which is under our law generally made by the oral evidence of witnesses, who, from the very character of their retainer on behalf of plaintiff or defendant, often fail to dissociate from themselves the imputation of advocacy, and the nature of whose testimony has given rise to an observation attributed to a late eminent judge, that "professional "witnesses not unfrequently become witnesses by profession." It is clear that, in litigation in which technical matters are involved, the court must obtain information from persons acquainted with the art or trade in question. The court has to apply the law on the basis of facts of which it can only have cognizance when they are proved before it either orally or in writing.

The experts are generally three in number, are appointed by the court, and report to it. The parties may object to the nomination of an expert on certain defined grounds, such as relationship or connexion with one of the parties; having been in any way concerned in the proceedings; having expressed an opinion on the matter in dispute; or being known to be hostile to one of the parties. They are sworn to honestly fulfil their duties, and, when once sworn in, it is compulsory on them to proceed and make the report. They are not arbitrators, who are really judges, and decide the case; they merely ascertain the facts, and report their professional opinions. They hold an inquiry on the spot, the parties being summoned to attend, and having the right to be present, and to assist at the inquiry—in fact, at all that forms a material part of the *expertise*, except the preparation of the report, which is, of course, carried out by the experts in private.

The report consists of two parts:—

(*a.*) The *procès-verbal*—statement of proceedings, and of the facts as ascertained.

(*b.*) The *avis*—the opinion or recommendation at which the experts have arrived as the result of their consideration of the facts.

When the three differ in opinion, and are not of accord in making one report, such opinions and the grounds of difference must be stated without indicating which is the personal opinion of each. The court is not bound to follow the recommendation of the experts, but consults it for information, and makes such use of it as it thinks fit. It is, therefore, desirable that the reasons for the recommendation should be given, but that the mind of the court should not be prejudiced, as it might be by the names of the experts being attached to each opinion. Occasionally in English practice, in the Common Law divisions, and more frequently in the Chancery division, the courts have desired to be informed of facts by independent experts instructed by the court; but, so far as I am able to form an opinion from cases I have read, the French system I have slightly sketched appears better adapted to ascertain the truth, and correctly inform the mind of the court, than our system of "teams" of witnesses, who are

often cross-examined by council whose deficiency of technical knowledge places them at a disadvantage, while the contradictory testimony of the witnesses confuses the court, and obstructs the administration of justice.

Privilège of architects and contractors over the works of construction they have carried out, to secure them payment for their work, gives them the right of being paid out of the proceeds of the sale of the property in preference to the creditors of the owner, even as mortgagees. A similar privilege was accorded in Roman cities by Marcus Aurelius, but applied only to the rebuilding of destroyed premises, in order to give architects and builders an encouragement which would facilitate the embellishment of the cities by the prompt restoration of ruinous buildings. "*Ne urbs ruinis deformaretur.*" But, tempting as the prospect of thus securing payment may be, stringent formalities must be complied with before the *privilège* can be obtained.

Thus, before the commencement of the work, an expert named by the Tribunal of First Instance of the district in which the works are situated prepares a *procès-verbal* describing the condition of the property at the time, the object being (1) to preserve the value of the property as it exists before the works, for the benefit of the creditors who may already have a charge upon it; (2) to afford a basis for ascertaining after the completion of the works the augmentation of value of the property resulting from such works, and it is only over this augmentation that the *privilège* can be exercised.

Within six months from the completion of the works they must have been accepted by an expert similarly appointed. He may be the same that acted at the commencement, but must be newly appointed. He prepares a *procès-verbal* descriptive of the works and of their cost. These two documents must be registered at the Bureau des Hypothèques of the district, and it is only then that the *privilège* can be obtained.

Frequently, to avoid these formalities, architects and contractors are content with a charge on the property, either by the terms of the contract or by a separate deed; but this security is far inferior to that obtained in the more formal manner.

Permit me, in conclusion, to say that the cordial thanks of this Conference are due, and will, I hope, be warmly accorded, to those Corresponding Members of the Institute who have so kindly and so carefully answered the inquiries addressed to them by the Committee.

ARTHUR CATES.

[Remarks by Charles Lucas, *Hon. Corr. Member.*]

Comme membre de la Société Centrale des Architectes, je constate avec satisfaction l'honneur qui rejaillit sur elle de voir ses efforts aussi bien appréciés par vous et, collaborateur du *Manuel des Lois du Bâtiment* et secrétaire du Congrès International des Architectes de 1878, je ne puis que me féliciter des emprunts que l'honorable M. Cates a bien voulu faire à ces deux ouvrages. Mais, veuillez laisser à l'étude les différentes questions qu'il à soulevées, surtout les deux plus importantes, les Honoraires et la Responsabilité, et je vous promets, ou plutôt j'espère fermement que, d'ici peu, la Société Centrale des Architectes qui reprend, elle aussi, l'étude de ces deux questions, vous fournira quelques nouveaux éléments. Pour les honoraires, un grand nombre des membres de la jeune génération, de ceux qui sont engagés dans la lutte de chaque jour, voudraient sortir de l'usage du 5 p. % et tenter

d'acclimater en France un tarif doublement proportionnel, dans lequel le chiffre d'honoraires croîtrait avec la somme de travail et de talent exigés de l'architecte et décroîtrait en revanche par suite de l'augmentation du chiffre de la somme dépensée. Mais ce tarif, tarif venu d'Allemagne et édicté au Congrès de Hambourg de 1868, est, à notre avis, trop compliqué pour pouvoir jamais servir à régler en France les obligations du client envers son architecte ; et, à mon sens personnel, un tarif français, plus récent, imposé par la Ville de Paris à ses architectes et décroissant par ½ p. %, depuis 6 % pour les premiers 200,000 f. de travaux jusqu'à 4 p. % pour les travaux 800,000 f. à 1,000,000 et restant ensuite à ce taux de 4 p. %, semble beaucoup plus pratique; il est vrai que ce tarif municipal offre cette lacune de ne pas tenir compte de la nature du travail et rétribue autant l'architecte qui construit une école élémentaire que celui qui construit une église, égalité dans la rétribution qui est tout-à-fait contraire au principe du tarif allemand. Il est un autre danger que peut soulever l'étude de la question des honoraires, danger apparu dans nos discussions en 1878, et qui pourrait amener des rivalités dans une société confraternelle: ce serait d'attribuer, dans un tarif édicté au nom d'une Société, des honoraires plus considérables aux architectes qui auraient une plus grande notoriété d'études ou de talent, et de créer ainsi des officiers de tous grades dans cette armée formée par les membres de notre profession libérale confraternelle. Quant à la *Responsabilité,* un seul mot ; au récent Congrès de Nice cette question est revenue à la suite d'une remarquable Conférence de M. Hermant, l'un des principaux collaborateurs du *Manuel des Lois du Bâtiment,* et il a été exprimé un vœu dont la Société Centrale des Architectes étudie la réalisation, vœu appelant la création d'une *Caisse* dite *d'assistance Judiciaire,* et destinée à soutenir, après examen par le Conseil Judiciaire de la Société, celui des membres adhérents à cette Caisse qui, attaqué à tort sur une question de Responsabilité ou sur toute autre question d'intérêt professionnel, ne serait pas en mesure de supporter les frais d'un procès toujours long et fort coûteux. Je ne sais si je me fais bien comprendre et si j'expose suffisamment tout l'intérêt d'une pareille création ; mais elle me semble appelée, si elle est réalisée, à faire honneur à toute Société qui l'entreprendrait, et à resserrer les liens de confraternité qui doivent unir tous ses membres.

CHARLES LUCAS.

[APPENDIX.]

TARIFF FOR CALCULATION OF PROFESSIONAL CHARGES OF ARCHITECTS.

Drawn up by the Architectural Section at the Fifteenth Congress of German Architects and Engineers, Hamburg, 1868.
Adopted by the Association of German Architectural and Engineering Societies, 1871.

The several Classes of Rates in the following Table relate to the corresponding Classes into which buildings and works are divided according to their nature, which are as follows :—

Class I.

(1) Ordinary agricultural buildings of all kinds.

(2) Buildings with large open interiors, of simple construction and fittings (store-houses, gymnasiums and markets, riding-houses, railway-station out-buildings, temporary buildings for exhibitions or festivals, &c.).

(3) Factory buildings of simple construction, consisting chiefly of large spaces, workshops, &c. (spinning-

mills, weaving-mills, sugar-works, glass and porcelain works, foundries, machine-shops, &c.). In all cases, the building only, exclusive of any fitting-up of machinery, &c.

(4) The plainest description of town and country dwellings (artizans' and agricultural labourers' dwellings, &c.).

Class II.

(1) Stable-buildings as accessories to villas ; stables for horses used for recreation merely, stud-buildings.

(2) Buildings with large open interiors, included in Class I. (store-houses, gymnasiums and markets, riding-houses, railway-station outbuildings, temporary buildings for exhibitions or festivals, &c.), when their construction, decoration or design, is in excess of what is usual for such buildings. Ordinary conservatories and orangeries or greenhouses. Also the factories enumerated in Class I., consisting chiefly of large spaces, workshops, &c. (spinning-mills, weaving-mills, sugar-works, glass and porcelain works, foundries, machine-shops, &c.), when their construction, decoration or design, is in excess of what is usual for such buildings. Lastly, all other factory buildings of complicated constructional arrangement.

(3) Better middle-class dwellings in the country, and the majority of town dwellings of ordinary construction and fitting (parsonages and plain villas, ordinary lodging-houses, plain houses for private families, plain inns, &c.).

(4) Public buildings of the plainest description (primary schools, polytechnic schools, grammar schools, churches of plain design, poor-houses, plain hospitals, baths and wash-houses, barracks, prisons, custom-houses, plain railway-stations, plain council-houses for small towns and buildings for local administration.

Class III.

(1) All better-class town dwellings and villas, viz., those with architecturally elaborated interiors (vestibules, well-staircases, shops, &c.), verandahs, summer-houses, ornamental conservatories and greenhouses.

(2) All public buildings included in Class III. (primary schools, polytechnic schools, grammar schools, churches of plain design, poor-houses, plain hospitals, baths and wash-houses, barracks, prisons, custom-houses, plain railway-stations, plain council-houses for small towns and buildings for local administration), when they receive ornamental architectural treatment or contain fittings requiring unusual and special study, whether as regards warming and ventilation or in any other respect.

(3) All other public buildings of high architectural character in the interior as well as exterior (high-class school-buildings, elaborate churches and chapels, libraries, museums, buildings for zoological gardens, pump-rooms and assembly-rooms, bazaars, club-houses, gala-rooms and ball-rooms, theatres, concert-rooms, exchanges, large railway-stations, head custom-houses, courts of justice, council-houses in large towns, buildings for ministerial and central administration, parliament-houses, &c.).

Class IV.

Dwellings and villas of a princely character, castles and palaces, highly ornamental churches and chapels, sumptuous club-houses, gala-halls, theatres, museums, council-houses and parliament-houses, portals, triumphal arches, &c.

Class V.

(1) Interior and exterior decorations.

(2) Altars, pulpits, baptismal fonts, organ-cases, &c. Monuments of all kinds, fountains, ornamental settings for wells or springs, alcoves in parks, &c.

Remarks.

1. For sums below 2400 mks. the tabular percentages increase at a like rate in proportion as the amount decreases, and take an additional final increase for sums below 300 mks.

2. The percentages given in the Table refer to the total estimate of cost. As consequently, however, the fee upon estimates only slightly exceeding the minimum limit of a tabular division would in many cases be less than upon estimates not exceeding the maximum limit of the next lower division, the fee upon the maximum limit of any division applies to all estimates in the next higher division until the amount of the estimate, at the percentage rate of such higher division, produces a larger fee. [*Note by Translator*:—In other words, the minimum fee on any estimate in one division shall not be less than the fee belonging to the maximum limit of the division next preceding. *Ex. gr.* The fee for (A) preparing sketches for a work in Class III. whose total estimated cost is 73,000 mks. would, if reckoned at 0·5 per cent. (the rate belonging to the division 72,000-120,000), amount to only 365 mks. ; whereas the fee for the same service in the case of

a work whose total estimated cost is 72,000 mks. would (being calculated at 0·6 per cent.) amount to 432 mks. To obviate this anomaly, the rule provides that a fee of 432 mks. shall be payable on all estimates from 72,000 up to 86,400, beyond which point the 0.5 per cent. applies up to 120,000 mks.]

3. Fees on rebuilding or additions [to existing buildings], when a special design is necessary, shall be calculated at one-fourth more, and, when a design is not necessary, at one-fourth less, than for the same class of new work.

4. Fees on works included in Class V., when the commission comprizes several of them, shall be calculated separately. When, however, they are component parts of a new work, the fees for them shall not be specially reckoned.

5. All expenses connected with the specified services, for draughtsmen, accountants, clerks, writing and drawing materials, and for maintaining, warming and lighting, the office used for the purpose, shall be borne by the architect. On the other hand, the client shall defray the cost of special superintendence and office expenses for the same. The duty of keeping a journal of the work, of examining and checking the building accounts as to measurements and weights, devolves on the "inspector" paid by the client; and expenses incurred by the architect for measuring-up, &c., in consequence of no superintendent being employed, shall be defrayed by the client.

6. Fees for the following services cannot be computed on the basis of the estimate :—

(*a*) Special work in or out of doors, as consultations, valuations, local inspections, audits, &c., shall be paid at a daily rate, as follows :—

½ day, of 4 working hours, not less than	12 mks.
1 day, of 7 working hours, not less than	21 „
2 and 3 days and upwards, each of 7 working hours, not less than .	18 „

(*b*) Time occupied in travelling on account of services for which the architect is paid according to the Table shall be paid-for at half the above rates.

(*c*) Travelling expenses are to be the bare actual cost of transit, and subsistence-money may be charged at 7·50 mks. per day and 4·50 mks. per night.

7. Advances on account during the work, in proportion to the progress of the work and in accordance with the foregoing rules, shall always be paid to the architect on demand.

8. If the estimate be exceeded, such excess shall not increase the fee. But the cost of duly sanctioned extensions or more sumptuous treatment of the work shall increase it.

9. All drawings remain the property of the architect; the client may demand copies of the design, but shall use them only for the work to which they relate.

SCALE OF PROFESSIONAL CHARGES IN GERMANY.

The Amount to be calculated at the undermentioned Rates per Cent. on the Estimate of Cost.

	Particulars of Service to be performed by the Architect.	CLASS I. Amount of Estimate (Marks).									CLASS II. Amount of Estimate (Marks).								
		2400 to 6000	6000 to 12000	12000 to 24000	24000 to 48000	48000 to 72000	72000 to 120000	120000 to 300000	300000 to 600000	600000 & upwards.	2400 to 6000	6000 to 12000	12000 to 24000	24000 to 48000	48000 to 72000	72000 to 120000	120000 to 300000	300000 to 600000	600000 & upwards.
A.	SKETCHES. Preparing Sketches (Plans and Elevations) drawn to Scale, and (if desired) an approximate summary Estimate of Cost.	0·7	0·6	0·5	0·5	0·4	0·3	0·3	0·25	0·2	1·1	0·9	0·7	0·6	0·5	0·4	0·4	0·3	0·25
B.	DESIGN. Preparing complete Design, with Plans, Elevations and Sections, together with a summary Estimate of Cost as for A.	1·0	1·0	0·9	0·8	0·7	0·6	0·5	0·4	0·4	1·2	1·2	1·1	1·0	0·9	0·8	0·7	0·7	0·6
C.	WORKING DRAWINGS AND DETAILS. Preparing the requisite Working Drawings and the Detail Drawings of Construction and Decoration.	1·0	1·0	0·9	0·8	0·7	0·6	0·55	0·5	0·4	1·4	1·4	1·3	1·2	1·1	1·0	0·9	0·9	0·8
D.	ESTIMATE OF COST. Preparing a special Estimate of Cost of Construction.	0·6	0·5	0·5	0·4	0·4	0·4	0·3	0·25	0·2	0·7	0·6	0·6	0·5	0·5	0·4	0·35	0·3	0·25
E.	EXECUTION. Drawing up Contracts for, and Letting, and general Superintendence of the execution of, the whole of the Works, exclusive of special Superintendence.	1·2	1·1	1·0	1·0	0·9	0·8	0·7	0·6	0·6	1·6	1·5	1·4	1·3	1·2	1·1	1·0	0·9	0·9
F.	ACCOUNTS, &c. Checking and Certifying the Accounts, exclusive of Measuring-up.	0·5	0·4	0·4	0·3	0·3	0·3	0·25	0·2	0·2	0·5	0·4	0·4	0·4	0·3	0·3	0·25	0·2	0·2
G.	ENTIRE SERVICES.	5·0	4·6	4·2	3·8	3·4	3·0	2·6	2·2	2·0	6·5	6·0	5·5	5·0	4·5	4·0	3·6	3·3	3·0

	CLASS III. Amount of Estimate (Marks).									CLASS IV. Amount of Estimate (Marks).									CLASS V. Amount of Estimate (Marks).								
	2400 to 6000	6000 to 12000	12000 to 24000	24000 to 48000	48000 to 72000	72000 to 120000	120000 to 300000	300000 to 600000	600000 & upwards.	2400 to 6000	6000 to 12000	12000 to 24000	24000 to 48000	48000 to 72000	72000 to 120000	120000 to 300000	300000 to 600000	600000 & upwards.	2400 to 6000	6000 to 12000	12000 to 24000	24000 to 48000	48000 to 72000	72000 to 120000	120000 to 300000	300000 to 600000	600000 & upwards.
A.	1·4	1·1	0·8	0·7	0·6	0·5	0·4	0·4	0·3	1·7	1·4	1·2	1·0	0·8	0·6	0·5	0·5	0·4	2·0	1·6	1·3	1·1	0·9	0·7	0·6	0·5	0·5
B.	1·4	1·4	1·3	1·2	1·1	1·0	0·9	0·85	0·8	1·6	1·6	1·5	1·4	1·3	1·2	1·1	1·0	0·9	1·7	1·7	1·65	1·6	1·5	1·4	1·3	1·2	1·0
C.	2·0	1·9	1·8	1·7	1·6	1·5	1·4	1·4	1·3	2·9	2·9	2·8	2·7	2·6	2·5	2·3	2·1	1·9	3·7	3·7	3·7	3·6	3·5	3·3	3·1	2·9	2·6
D.	0·7	0·6	0·6	0·5	0·5	0·4	0·4	0·3	0·25	0·7	0·6	0·6	0·5	0·5	0·4	0·4	0·3	0·3	0·8	0·7	0·6	0·5	0·5	0·5	0·4	0·3	0·3
E.	2·0	1·8	1·6	1·5	1·4	1·3	1·2	1·1	1·1	2·1	1·9	1·8	1·7	1·6	1·5	1·4	1·3	1·2	2·2	2·0	1·9	1·8	1·7	1·6	1·5	1·4	1·3
F.	0·5	0·4	0·4	0·4	0·3	0·3	0·3	0·25	0·25	0·5	0·5	0·4	0·4	0·3	0·3	0·3	0·3	0·3	0·6	0·5	0·45	0·4	0·3	0·3	0·3	0·3	0·3
G.	8·0	7·2	6·5	6·0	5·5	5·0	4·6	4·3	4·0	9·5	8·9	8·3	7·7	7·1	6·5	6·0	5·5	5·0	11·0	10·2	9·6	9·0	8·4	7·8	7·2	6·6	6·0

XIV. THE TENURE OF LAND FOR BUILDING PURPOSES.

By Thomas Blashill, *Fellow*.

[Read* on Wednesday, 7th May 1884, Edward I'Anson, F.G.S., *Vice-President*, in the Chair.]

THE tenure of the land upon which buildings are erected is a matter of the greatest public importance, and one which, from various causes, is now receiving an unusual amount of attention. So far as it affects the condition of buildings, their capacity for improvement, and their influence upon owners, occupiers and neighbours, it is a question belonging peculiarly to our own experience. We should therefore be able to deal with it practically, and unbiassed by considerations of class or party.

With a view of assisting us in the discussion of this subject, inquiries have been made of our foreign correspondents as to the customary tenure of building land in the chief European countries. We find that in France, Germany, Austria, Denmark and other countries, buildings are erected only upon land which we should call freehold, so that there is no such question as that which is now before us, and we can learn nothing from their experience of different tenures. If our country resembled any of these in its capacity for business, and in the prosperity of its population, their example would be of great value, but in existing circumstances we shall probably do well to study the subject from our own point of view.

We shall, no doubt, agree that, in principle, it is best for a man to be able to build upon his own freehold land. He ought to be the best judge of his requirements and of his means. If he builds on speculation, or for investment, he ought to know best the wants of his customers or tenants, and the price at which they will buy or hire. It is most to his interest to keep the premises in good repair, to alter them judiciously, to enlarge or rebuild, as circumstances require. If his judgment is good, the gain is his; if bad, the loss is his. But if, through the tenure of his land, he has to submit his judgment to some other person, he is very likely to be fettered in his action, and may have to pay heavily for liberty to do what he considers best. This freehold tenure is what each would think best for himself. It is also best for other people if we add the restrictions that are required in the public interest, and those which may be desirable between neighbours for their mutual advantage.

The tendency of modern legislation has been to promote the conversion of other ancient tenures into freeholds, and to make the freeholder, though he may be only a tenant for life, more free in the use of his land. If the land is in London or any of our larger towns, the use which he makes of this freedom is to dispose of it on building-lease, so that the property, which before might be tied up only for the present generation, becomes tied for the duration of about three generations to come. Our subject may, therefore, be limited to the forms of leasehold tenure on which land is now let for building purposes, and specially to the system of terminable leases, which has for a considerable time prevailed in London, and is being extended

* At the Third Meeting of the General Conference of Architects held in London from the 5th to the 9th May 1884.

to our largest provincial towns. And it will be useful to bear in mind the convenience of freehold tenure in judging of other modes of holding building-land.

Now the system by which a person intending to build hires a piece of land instead of buying it, and covers it with buildings which his representatives must at the end of ninety-nine, or ninety, or eighty, or perhaps only sixty years, give up in tolerable repair to the ground landlord, is one which is peculiarly liable to be misunderstood by those who are unacquainted with such business. As a subject for a telling speech or a smart article, we are familiar with the picture of rows of houses run up to last only so many years as the lease will endure. They are supposed to fall in pieces about that time, after having been, during their later years, the disreputable means by which the middleman has satisfied his "greed" at the expense of the unfortunate tenants. At the end of the lease the holder is a poor widow who is solely dependent upon the property, and finds it "confiscated" "without any compensation" by the ground-landlord, who, moreover, endeavours to make her restore it to a habitable condition!

It is hardly necessary to point out that these pictures give no true idea either of the nature of this transaction or of its practical results. The deliberate building of a house to last for about the term of the lease is a popular fallacy. The buildings with which it is connected are the work of the worst class of speculating builders, who have no interest in or care for the length of the lease. They build to sell, and they hope that their own interest will cease as soon as their buildings are finished. Under such conditions they would build as badly on their own freehold ground, or worse, for they would in that case be free from the supervision of a ground landlord. Houses of this class seldom last for half the usual term of a building-lease without serious dilapidations. I have had to procure their demolition before they were finished, and have known them to become uninhabitable before they were occupied. Some of the worst of these buildings have been built on the speculator's own freehold ground. When houses are manufactured in large numbers for sale it is highly improbable that the buyer can exercise any useful supervision over their erection, and nothing but building regulations of a stringent character can prevent this kind of work, or give a chance for the respectable speculator to compete with those who have no desire to build substantially,—perhaps no knowledge, even, of the ordinary principles of sound building. The regulations in our Metropolitan Building Acts are more lax than those of many provincial towns, and far behind those of the large Continental cities. They may, nevertheless, be quite equal to the demands of the public, for a very large proportion of our population do not practically call for well-built houses by showing a readiness to pay for them.

But the man that builds for his own occupation or investment, *and intends to keep the property in his family*, will hardly have the folly to build in an unsubstantial manner, for any serious defects in construction will show themselves within the term of a building-lease, and the penalty would fall upon him or his near descendants. A man of ordinary prudence, having built substantially on his leasehold ground, will, if he cares more for his posterity than he does for himself, lay by a sum which will probably be only a few shillings per annum to form a fund that shall, at the end of the term, be equal to the original cost of the building. If (as may be very reasonable) he cares more for himself than for his remote and problematical descendants, whom he will never see, he will allow the matter to take its course. At every change of ownership, whether by inheritance or by purchase, and at any time during the continuance of the

lease, the temporary leaseholder will know how long the property will remain to him, and how far that influences its value. If he has the ordinary good fortune of the London leaseholders of past times, he will be in receipt, during the latter half of the term, of an income from the property very considerably in excess of that calculated upon by the original lessee, while he will still be paying only the original ground-rent of one-half or one-fifth of the increased value of the building-plot.

Meanwhile the ground-landlord has been unable to share in this prosperity. If the property be in central London, he may still be receiving the ground-rent fixed early in this century, when men of business lived over their shops and offices in streets lighted by oil-lamps, before railways, free-trade, telegraphs, cheap postage, cheap newspapers, and all the aids to commerce which have marked the last two generations, were in the least foreseen. The ground-landlord in one of the suburbs may still be limited to the rent fixed when that suburb was an outlying village, without trade, without cheap communication, and separated from the great centres of business and of pleasure by roads infested with footpads by night, and, according to modern notions, hardly passable by day. The improved rentals, which he may never live to enjoy, are probably shared by middlemen, representatives in different degrees of the interest of the original lessee.

In discussions of our leasehold system these considerations are generally overlooked. In a paper in the *Fortnightly Review* for March last, by Mr. Broadhurst, M.P., who has taken a great interest in this subject, and whose Bill for enabling leaseholders to purchase the fee-simple was lately before Parliament, there is this story, which the writer evidently thought to be a strong support to his case:—

> "A person had bought the remainder of a lease on a West-end estate, and towards the "end of the term he sought a renewal. The terms offered were as follows:—1. That "the original ground-rent should be increased from 10*l.* to 50*l.* per annum. 2. "That a fine of 1,400*l.* should be paid for the privilege of renewal. 3. That 500*l.* "should be expended in repairs by the lessee."

Now, it will strike men of business that the thing which would have shown whether this was fair to the lessee or hard upon him, viz., the actual present value of the premises (which he had, no doubt, bought prudently, but which he seems to have neglected) is omitted from these particulars. The same fault usually marks such stories as these, by which a lessee who desires to have a benefit that does not belong to him practises on the good nature of a sympathetic member of Parliament.

Every loss which a lessee may sustain can be estimated in pounds and stated in figures. We shall probably be of opinion that the losses said to be incurred by the holders of terminable leases (which have been entered into with ordinary prudence) will not bear that test; but it does not therefore follow that terminable building-leases are desirable as a system, and to the extent to which they are now being adopted. When the original parties to the lease have passed away the property has to be managed for some two generations under the covenants made by these dead people, and with strict reference to the supposed interests of a reversioner who may not yet be born. The character of the neighbourhood, the circumstances of the property, may be entirely changed, and the only person who can adapt the premises to the new conditions is the then holder of the lease, who, besides, may have his own means of increasing the value of

the premises to himself without any real injury to the ground landlord. He may even desire to rebuild or greatly improve the premises for the benefit of both parties. In any case he must apply for the consent of another person, who may exact an enormous consideration for it, or may, from ill nature, refuse point blank. If he is not really in bad hands he may find that, through the nervousness of trustees, or the caution of professional advisers, he is so hampered in his arrangements that his scheme has to be abandoned. If his lease is about half run out, the cost of extensive additions will fall so heavily on the short remainder of it that he may then be tempted to build in a flimsy manner. When the lease draws still nearer to its end, it is decidedly against his interest to keep the premises in proper repair, and the Legislature, in passing the Conveyancing Act of 1882, has taken such care of the interests of such persons that it will now be exceedingly difficult for the ground-landlord to compel the performance of repairing covenants. Hence arises much of the present outcry against leasehold property, though it will be found that much of it is really due to the indifference of freeholders, who are, perhaps, only tenants for life. These results of the system of terminable leases are a matter of public concern; for it is to the public injury that large areas of the metropolis should be checked in the ordinary progress of improvement for the term of two generations. It is a matter well worthy the careful consideration of those most intimately concerned with the working of the system,—the ground-landlords and their professional advisers. In my own experience I am bound to say that I have found that, in dealing with the larger corporate bodies, and with the ground-landlords of large private estates, the tenant has usually been treated not merely with fairness, but with the liberality which one likes to see accompanying the sentiment of ownership. I have also known the owners of a small estate make a great sacrifice to relieve an unfortunate tenant. But there are some large public bodies who are said to be not so well advised that they can safely be trusted to act liberally, and small people cannot be trusted to any great extent.

I do not, however, think that we shall approve recent schemes for the compulsory purchase of leaseholds. Such schemes would enable a lessee who desired to improve the property to become the owner of it, and so far that would be to the public advantage; but they would open the door to a class of schemers who would use the enfranchised leaseholds as a means of injuring estates on which none of the evils now complained of really exist. It would be a strange mode of rewarding the owner of neglected leasehold property if we enabled him to buy at the price which a willing purchaser might give for the rookeries which are the result of his neglect.

Before we consider improved forms of tenure it may be interesting to give the view of the only permissible form according to the ideas prevalent in Spain. Señor Belmas, writing from Madrid to Mr. R. Phené Spiers, says, "Every one who wishes to build begins by purchasing his "ground, and, without being the absolute proprietor, no one would think of building even the "least thing. On the contrary, if by chance what is done in England were known it would "astound every one." Are we in London prepared to return to that primitive system? or to pass any Act of Parliament that would practically enforce it? There is a Royal Commission now sitting, which will doubtless tell us how it is that in England,—the most prosperous country in this hemisphere at least,—men will not, as a rule, even when they might, acquire the freehold of the houses in which they live; why, when they happen to be the proprietors of their

cottages, they sell them on the first opportunity; why the Englishman devotes a smaller proportion of his income to house-rent than any other man; why house-rent in London is cheaper (like for like) than in any important Continental city; and how it happens that the average London householder does not live more than three years in the same house. If it is argued that any of these things are due to our system of terminable leases, they will find that they exist, and have long existed, so far as a comparison can be drawn, quite independently of them. If it is argued that the slums of our great cities are due to the leasehold tenure, we may ask how it happens that evils quite as great have arisen in the great American cities, from New York to Chicago, where no such leases exist; and why the slums of Paris, though less extensive than our own, show, if possible, more shocking phenomena.

For our own part, we have to deal with things as they exist. In a state of society in which it is more convenient to build upon leasehold land than to buy the freehold, we must consider how much of the convenience which belongs to freehold can be grafted upon the leasehold tenure, especially in the point which most affects the public interest, which is to secure to persons having control and substantial interest in buildings reasonable liberty and encouragement to improve the property.

There are, in various parts of England, customs of holding land subject to chief-rents or fee-farm rents, about which I hope we may hear something from those who have practical experience of their working. The effect of such terms is to create what we might call leases in perpetuity, if such things were legally possible, and the best example of this on an extensive scale is found in Scotland, where building-land is commonly let on what is called a "feu charter." By this system the tenant is bound to keep a building upon the land of twice the annual value of the amount of the rent. The rent does not increase, but it is easily collected, and forms, in Scotland, the best available kind of investment. We may hope to hear from some of our Northern friends the advantages and the disadvantages (if any) of their system; but it appears that if this tenure were known here, and the habit grew up of investing in such securities, the objections to building-leases would disappear. It appears also that the ground-rents under such a tenure would rise very considerably beyond the rates that are now paid. The increased rent should not only remunerate the ground-landlord for the loss of the reversion to the site at the end of a terminable lease, but it would include some share of possibilities of improvement which are prevented by the present system, to the loss of both lessor and lessee.

There are certain classes of ground-landlords, such as corporate bodies, charitable trusts, and some heads of families who might not be tempted by these increased rentals. But the ordinary owner of land for investment may well consider the advantage of such a system of letting building-land. I feel sure that its adoption would lead to the application of the same system in many cases where a lease has so many years to run that the present owner of the freehold cannot expect to enjoy the reversion. In such cases it would be easy to ascertain the value of that reversion, and to fix an increased ground-rent which would give the present owner the full income which his land may now be worth. Probably such leases would be made renewable periodically at a fixed nominal fine; but the precise shape which the legal business would take is a matter for lawyers rather than for surveyors.

I understand that in Aberdeen a system has grown up of letting building-land for a term

of sixty years, the ground-rent to be doubled after a lapse of the first twenty-five years, for some reason which I fail to see. If we admit the principle of an increasing ground-rent, it would seem more fair to provide for a revaluation of the ground, say three or four times in a century, and at such times renewing the lease at the new rent. This would make the lease-holder in the same position as the holder of freehold land except that he must allow the ground-landlord to share in the increase (and possibly in some cases the decrease) of the value of the property.

There is in the West of England a very important question arising out of the local custom of building upon leases for lives. Whatever the advantage of such a tenure may have been in past times, its uncertainty conveys to us the idea of a gambling transaction, such as must be highly prejudicial to business. It is, of course, possible to insure the lives, and every careful lessee would do so, but the cost of such insurance, and some share in all the other inconveniences of such an uncertain tenure, must fall on the ground-landlord, and it seems surprising that such a custom has not been abandoned in the interest of both parties.

In bringing this subject before the Conference I have endeavoured to touch upon those questions which are of the greatest importance, but I do not suppose that I have included everything that is worthy of consideration. We can have (as I have hinted) no political views; we are, therefore, the more able to place the whole matter in its true light, so that defects in existing customs may be remedied by those who are practically engaged in the management of these transactions.

THOMAS BLASHILL.

[Remarks by John Honeyman, *Member of Council.*]

There is I think a good deal of misapprehension generally as to the working of the leasehold system in England and elsewhere. I confess that before I looked into the subject with some care lately I felt very much prejudiced against the system; but the last thing that would suggest itself to me as a remedy for the evil would be the interference of Parliament in the matter. Reform is likely to spring from increased enlightenment on the part of those who are specially interested, and it will be doubtless better for the community at large that both parties to any contract of the kind should be perfectly free. The evils of the leasehold system have been greatly exaggerated, and this has been clearly brought out by Mr. Blashill in his Paper. Indeed, the chief evil seems to be the power of the ground-landlord to interfere unduly during the currency of the lease. In that respect there can be no doubt that the system in the North is superior, there being no interference so long as sufficient value on the land affords security for the payment of the feu-duty, as it is called. A feu is nearly equivalent to a perpetual lease. But land under a feu-charter is conveyed absolutely to the feuer, and becomes his property, which he in turn may sell or feu or lease if he thinks proper. There is no interference on the part of the ground-landlord unless, as sometimes happens, the feuer has come under covenant to do certain things upon the land and fails to do them. [THE CHAIRMAN.—Do I understand you to say that the feuer is under certain covenants to do certain things?] It frequently happens that to secure the amenity of a locality this is the case. For example, there may be a condition in a feu-charter that only dwelling-houses are

to be erected upon the land, and possibly in conformity with certain plans, or a certain building-line is prescribed, or the kind of fencing along the frontage, or the like. It is a sort of compromise between the Spanish system, which requires the absolute purchase of the ground, and the English system, by which the land is simply secured for a certain number of years. It does not entail the expenditure of so large an amount of capital to begin with on the part of the man wishing to build; in point of fact, he does not spend anything on the land,—unless he thinks proper to buy up the feu-duty,—the land is his, and yet he only begins, the year after completing his bargain, to pay a small sum. There is also this great advantage to the proprietor, that he has no trouble connected with the land. The feu-duties are a first charge on the property, and he has no trouble whatever in their collection. This is one consideration which might lead freeholders in England, wishing to dispose of their land, to consider whether it would not be well for them to adopt such a system. A larger ground-rent would thus be obtained, and they would have decidedly less trouble, with freedom from litigation and all the expense arising, especially at the termination of a lease. My own impression is that it would really pay a ground-landlord much better to adopt this system. It is a question of assessing the value, but that, as Mr. Blashill has said, is a matter which can be easily worked out, and in this case it is done once for all; the feuer gets the benefit of any increment, as of course he ought. The largest estates in Scotland are held by precisely the same kind of tenure—many of them for a merely nominal duty or service.

JOHN HONEYMAN.

[Remarks by Professor Kerr, *Fellow.*]

The Scottish system is, in plain phraseology, simply a perpetual lease. Mr. Honeyman's idea, that a certain change in the value would be accomplished by means of a change of tenure from a terminable to a perpetual lease, is financially quite a mistake, because the value of a thing is what it brings, the more especially in transactions of this kind. It is therefore unnecessary for me to discuss that point. The perpetual lease is often granted in England, and the ground-rent of it is simply what the ground for the moment is worth. It will not, therefore, make any difference whether it is a lease for 50, 60 or 90 years, or, as in Scotland, a lease for 999 years, or for perpetuity. The system of granting leases is a thing which has grown up in England, not arbitrarily, but as part of the business of the country. Doubtless one most important factor in the production of this system has been the desire on the part of great families and corporations to perpetuate the possession of the land. The same principle may be said to prevail in Scotland; but as a Scotchman I am prepared to say that Scotland is far in the rear of England in commercial transactions, and it is a mistake to make any comparison between the two countries upon this question. In London, where the evil effects of the leasehold system are most noticeable, there can be no doubt that business suffers very considerably in certain respects in consequence of it. Every matter of advantage in business has its counterpart in disadvantage, and the disadvantages of the system are great and crying. At the same time I agree with what I understand to be the drift of Mr. Blashill's argument. It is not so easy to get rid of the disadvantages, but I do not agree with Mr. Honeyman in supposing that Parliament ought not to be encouraged to interfere. It is a great detriment to commercial business, in which regulation may fairly be said to be necessary. The absolute freedom of

landlord and tenant in their contract is a pretty thing in theory, but in practice, as in other matters, it requires regulation. Too often the typical landlord, when he finds he has got the tenant in his power, makes use of this power to his own advantage, as against that of the tenant. Measures have been successfully brought into Parliament some time ago whereby tenants in London are to be empowered to purchase their lands. I agree with Mr. Blashill that this is a measure which can scarcely meet with the approval of practical surveyors. It may answer all the purposes which Mr. Broadhurst has in view, if Parliament were to give the tenant the right of a renewal of the lease under certain circumstances in order to further the operations of an improvement on the property. If there were a statutory right of renewal, instead of a statutory right of purchase, it might do all that is necessary, without the interference of the prerogative of the ground-landlord. There is one forcible consideration in connexion with land tenure, viz. that the value of the ground is really created by the public. It is not inherited by the owner, but is caused by the extension of the town, by the traffic, and by the necessities arising out of it. I do not say that they can fairly introduce that into the argument in regard to the commercial transactions between landlord and tenant, but it is a consideration which in equity has a very great weight. When, therefore, I hear of ground landlords in London maintaining the bars across the roads, for the purpose of keeping up the value of the ground rents, I think the fact has not been sufficiently taken into account that the value of the land has been created by the very traffic which those bars impede. And when the ground-landlords come to Parliament, as some day they will come, to claim compensation for the alleged depreciation caused by the throwing down of those bars, some one should bring forward the argument that the very value with which they are dealing has been created by the traffic they had been impeding. Some of the great corporations in London are not at all liberal in these matters. I am sorry that Mr. Cates is not present, but my opinion is, that the Crown deals very illiberally indeed in connexion with the matter. Take the case, for instance, of Messrs. Howell and James, who had spent a great many thousands of pounds upon their premises on a thirty years' lease. I believe they applied *ad misericordiam* for a little extension of the lease, but that it has virtually been refused. I also know of a case in which there were only thirty-two years remaining, and where the houses were actually worn out. It was necessary in this case to erect an expensive building, and as an extension of the lease was refused, they had to put up a handsome building on a tenure of thirty years. Upon the estates of the Duke of Westminster, I believe, tenants are generally well satisfied with the terms on which renewals are granted. The desire of the great landowners throughout England has always been to work well with their tenants, and it is the same with great City Companies. As an instance of the complications which exist in London leaseholds, take the case of Regent Street, where the houses, generally speaking, are mere whited sepulchres. The buildings are such that the shop is worth as much as the whole of the house. That is produced by two causes. In the first place, the competition is such that anything like improvement by the tenants is heavily handicapped; and in the second place, the houses, being originally badly built, the ground upon which they stand is worth more than the ground and the house together, the value of the house being a minus quantity at the present moment. It seems to me that the leasehold system has reached the point of absurdity in the case of Regent Street. There is one consideration in regard to the rent of land in London which

should never be left out. If the lessee requires the renewal of his lease for the sake of his business, the lessor not infrequently raises the rent by selling to the man his own business. Then there is the question of the administration of the law in regard to dangerous structures by the Metropolitan Board using their surveyors as tools rather than as instruments. This has become a considerable grievance to tenants. A dangerous structure is very likely to be a house at the end of a lease, and I would ask, Is there no remedy for a tenant to compel the ground landlord to rebuild a portion of the house which is condemned? There is no remedy under the surrendering clause of the lease, and, although this might happen a week before the termination of the tenancy, the tenant must leave the house in proper habitable and tenantable repair.

ROBERT KERR.

[Remarks by John Hebb, *Fellow*, Assistant-Architect to the Metropolitan Board of Works.]

If there were no other arguments against the practice of leasing land than those which have been referred to by Professor Kerr, they would be sufficient to condemn it. There are also other grounds on which the system stands condemned. That it leads to flimsy, unsafe and undesirable building is to be demonstrated. Mr. Blashill has tried to show that people prefer to live in hired houses rather than in those which are their own property, and, that such being the custom in this country, it is impossible to change it. But it would be not unreasonable to take the other view, and to attribute the indisposition of Englishmen to remain long in one house to the fact that tenure is insecure, and there are no inducements to good building. It is the practice to put such stringent covenants into the lease that it is even a breach of covenant if a man improves a building leased to him without the consent of his landlord. As a rule, corporate bodies have no respect for persons; they let their lands and houses to the highest bidder, and the old lessee is in no better position than anybody else. Ecclesiastical bodies are notorious for their want of consideration for their tenants. Next to them, probably, come the corporate bodies, such as the City Companies, who invariably exact the utmost value of their property; and, being immortal, there is no chance of any alteration in their views. Warden succeeds warden, and they are all equally rapacious. There is no doubt that the present system of leasing land is one which cannot well be defended.

JOHN HEBB.

XV. THE LATE GEORGE EDMUND STREET, R.A., F.S.A., *President.*

By the Rt. Hon. A. J. B. Beresford Hope, M.P., *Past President.*

[Read* on Wednesday, 7th May 1884, Ewan Christian, *President,* in the Chair.]

THE notable feature of the distinguished life which I am called upon to commemorate was its harmonious, calm progressiveness. No lurid glare of romantic adventure lighted up or obscured the career of George Edmund Street: no feverish throw for the last stake, despair and ruin shaking the dice against success and honour, is there to tempt us to revel in the fallacious indulgences of word-painting. No dreary periods of obscurity gave fierce delight to unexpected bursts of hot prosperity. Ups and downs, of course, there were, success in this competition and disappointment in that one; carping criticism, and all other such episodes of rainy weather and storms which freshen the atmosphere of public life, and upon which it is the duty of every one to reckon who makes his choice for a public position. But in his professional career, which is all with which I am here concerned, Street's life was eminently one of a prosperity deserved, fought for, and achieved, by a rare combination of industry, realised duty, buoyancy, will and genius, in alliance with those gifts of manual dexterity in sketching, so useful to the architect who has always to be making himself understood by that Philistine public to whom elevations are masks not faces, plans deliberate frauds, sections aimless trifling.

The pupil of Owen Carter, of Winchester, in 1841, and then, in 1845, of George Gilbert Scott, Mr. Street found himself in 1849, and at the age of twenty-five, an architect with his own way before him to carve out, and so he carved away for every day of two-and-thirty years, till, after he had passed through the portal of the Royal Academy, that way ended in Westminster Abbey, where a funeral, only not a State one in the technical sense of the word, conducted to his grave the President of the Institute of British Architects and artist of the grand pile of National Law Courts. He began, as I said, to practise in 1849, at Wantage; in 1852 he went to Oxford, having been named Diocesan Architect by Bishop Wilberforce; and in 1856 transferred himself to London, which he never left,—so nobly simple was his career, which would hardly have been possible except in some great centre of life. It owed none of its success to dexterous compliance with popular tastes. Perhaps in his younger days our friend was a little too fond of emphasizing his independence. Street was a man of twofold convictions,—a Gothicist and a religious architect, as the Church of England teaches religion. Here let me for a moment forget that I have for my audience the Conference of Architects, and travel back in memory to some far-off meeting of ecclesiologists, at one of which I had the great privilege of making Street's acquaintance. As an ecclesiologist among ecclesiologists, I claim for Street,—and not for Street alone, but for the owners of other cherished and

* At the Fourth Meeting of the General Conference of Architects held in London from the 5th to the 9th of May 1884.

honoured names, some still with us, and others resting from their labours,—the credit of a rare example of truthful conviction, consistently acted out in the engagements of a lifelong career. I do not intend the slightest reflection on another theory of the architectural life; I honour the other conception of the architect's mission, that of subordinating personal predilections to the wants of the client, always with the reserve, of course, that the construction shall be good, and the design not ludicrous. The world could not go on without the existence of such a basis of reciprocal action. Indeed, the power of accommodating personal faith,—faith, I mean, in things terrestrial no less than celestial,—with professional want of prejudice, without forfeiture of self-respect, makes the world richer in its store of moral treasure. But yet I must be allowed to reserve peculiar personal admiration for the architect whose life of art is one long fearless creed, and who refuses to win fame or profit by ways adverse to the propagation of what he believes the highest truth. Architects of this type have been eminently the growth of England, and of the English Church of this century. Eminently,—I say no more when I think of Pugin, to mention but one name. The ecclesiological promise of France seemed as bright as ours forty years ago. It has been interred in chill silence at the civil funeral of Viollet-le-Duc, while from the graves of Scott and Street at Westminster the voice of sure and certain hope rises that our mission shall go on and prosper.

But let me not stray into controversial by-ways. I could not refrain from these words without leaving my picture of Street incomplete. To say more might be needlessly to raise debate. The man for whom I have claimed this merit was no pale, spiritless dweller among the tombs, but, up to all but the last day, a stalwart Englishman of vigorous vitality, robust constitution, unflagging spirits, beaming with the beauty of healthful activity, awake to the calls of that life in which personal capacity ministers to public prosperity. Let us briefly travel over the list of some of his principal works, after which I may offer a few remarks on the lessons which they teach. I dare not open the multitudinous roll of churches which have passed under his restoring but reverent hands with no detriment, except, it may be, in those early days when all were learners together. It is enough to name some principal works, such as the south transept of York Minster, Carlisle Cathedral, Kildare Cathedral, St. Canice Cathedral at Kilkenny, the noble churches of St. Peter Mancroft at Norwich, Clun, Welshpool and Hythe. The recasting of Christchurch Cathedral, Dublin, and, still more emphatically, the nave of Bristol Cathedral, are works in which the original element is too large quite to justify us in calling them "restorations"; nevertheless no other more appropriate word occurs. Of new churches due entirely to Street's inventive genius the earliest which calls for notice is St. James the Less, Westminister. All Saints', Boyn Hill, Maidenhead, with the adjacent block of almshouses, soon followed; then All Saints', Clifton, noteworthy for its noble span. Then come St. Mary Magdalene, Paddington; St. Philip and St. James, Oxford; St. John's, Torquay; the great church at Bournemouth; and, of a later date, Kingstone, Dorset; a series of churches in the East Riding of Yorkshire for Sir Tatton Sykes; St. Saviour's, Eastbourne; St. Margaret's, Liverpool; St. John the Divine, Kennington; the Garrison Chapel, Portsmouth; with the chapel at Dunecht; and his own particular church, St. Mary, Holmbury, near the beautiful retreat which he had built for himself. Abroad, Mr. Street constructed the Memorial Church at Constantinople; the American, and the rising English, churches at Rome; and he designed the American Church at Paris. Such are, perhaps, his most conspicuous churches; while there are two

cathedrals, which only exist on paper. The beautiful design, which won the second prize at the international competition at Lille in 1856 is well known,—better, probably, than the design for Edinburgh Cathedral, completed in 1872, which I have no hesitation in saying seemed to me of the highest merit; while, perhaps, its distinguishing qualities were those which caused it to be rejected, namely, its modesty and its scrupulous adherence to the stipulated price. Mr. Street with much precision grasped that smaller ideal of cathedral which is found in those parts of these islands which are not England, as at Kilkenny, Llandaff, and Dunblane, and reproduced it under conditions which left the building every inch a cathedral. However, a less original rendering, of the usual English type, was preferred.

I must now note two works which do not quite fall under restorations or new churches. First comes an effort of great ability and courage, the recasting of the interior of the dreary Guards' Chapel, which stands up like a starveling Greek temple in Birdcage Walk. The problem was to transfigure the inside while the architect was bound to leave the exterior in all its old hideousness. So there it now stands, all glorious within, full of thoughtful artistic beauty,—a church admirably adapted for Anglican worship, displaying loving care in every detail. Gothic would have jarred too harshly with the inevitable outside, so Street worked in a style in which Romanesque, referring backward even to San Clemente, is handled with an originality and an avoidance of anachronism which make it incontestably appropriate to its age, its country and its peculiar use.

The other speciality of which I may speak is the storied reredos (containing Refern's masterpieces of sculptured groups), which, together with Pugin's window, fills the east end of St. Andrew's Church, Wells Street.

Of religious buildings not churches, his earliest was the Theological College, Cuddesdon, —very picturesque, but no doubt too crowded. Later, and of broader design, comes St. Margaret's Convent, East Grinstead; while of works purely secular, let me first name the design which won a prize, more than a quarter of a century back, in the competition for the Foreign and War Offices. Dunecht House, Aberdeenshire, is highly spoken of, and a Gothic house in Cadogan-square does noble battle with the environing phalanx of Queen Anne conceptions. I pass over various parsonages and schools. Mr. Street's own house on the flank of Holmbury, Surrey, shows a masterful handling of the homely picturesqueness of the Tudor phase of our old national style. In another competition, the limited one for the National Gallery, Mr. Street was not successful, and truth compels me, as one of the judges there, to say that I do not think his design was one of his happiest inspirations. But a far more important competition was proceeding at the same time, the one for the Courts of Justice, and it is best to sum up this momentous chapter in the history of national architecture by saying that it has enriched this generation and this city with Street's great masterpiece in the Strand—a masterpiece of which we may well be proud, in spite of the mutilations to which it was subjected by official ignorance and parsimony.

I will not weary you with any longer list of those beautiful works sown broadcast over the land, in every place, so to speak, except, I grieve to say, Cambridge; but I turn to Street's literary work. I shall not attempt even to epitomise the long schedule of articles, papers, lectures, reports and pamphlets which dropped from his pen, winding up with that noble legacy, his very last effort of active intellect, the presidential address at the Royal Institute of

British Architects, of November 1881. Street has endowed architectural literature with two books. *Brick and Marble in Italy* first appeared in 1855, and made its author's name generally known. A second and enlarged edition appeared at a much later date. The second work is *Gothic Architecture in Spain,* which taught the superficial traveller that he had but touched the fringe of Spanish Mediæval architecture by visiting Burgos, Toledo and Seville, if he left Santiago, Gerona and many other noble minsters unvisited. Spain in Street's hands was no longer a Renaissance country with Mediæval exceptions, but as truly Gothic a land as England, France or Germany, and with closer affinities to them in style than Italy.

What are the lessons which we can draw for our benefit from this long record of prodigious brain activity? There are many, both artistic and moral, and there is one in particular which partakes of both natures, and which admits of concise statement—I mean the openness to conviction, the independence of mind, and the absence of false pride which led Mr. Street to change his style when he saw reasons to believe that he was marching along the wrong road. The pupil of Scott and the child of the Ecclesiological Society, he started in life with art principles of the more rigidly English orthodoxy. But he was actively and rapidly receptive, and his Italian tour wrought a great change in his views, and he returned full of the adaptability to home wants of many seductive features of Italian Gothic—cornices, plate tracery, brick and marble interchanged, and so forth. Of this influence St. James-the-Less, Westminster, is a notable instance, and signs of it are found in his offer for the Public Offices, in Cuddesdon College, and in Boyn Hill Church. Many architects followed in his wake, and the success of Italian Gothic seemed secured—not as an interesting and fruitful object of study—that it always must continue till taste and research are hissed off the stage—but as a style desirable to be used in England in conscious preference to the traditionary native forms. Though the building is not by Mr. Street, I may point to the Scientific Museum at Oxford as the climax of this phase of taste. Few as are by comparison the years which have gone since this building was hailed as an architectural revelation, they are nearly as remote as the days of Chambers and the Adam family, perhaps more so. By-and-by Street's candid mind and clear intellect realized that workaday Italian Gothic was for England a caprice, and he bravely returned to the purity and elasticity of the Edwardian style, only retaining, as he had a full right to do, the greater variety of materials in marble and brick and mosaic which modern commerce and processes had made available, and which could be developed on the lines of English composition with as much truth as upon those of a foreign style.

For a man to change once is not so uncommon, and the action may either show wisdom or the reverse, or simply come of unconscious drifting. But for a man to retrace his course after such a change, is either instability or heroism, and Street's practical retractation of that propagandism of Italian Gothic, in which he had shown himself so personally successful, partakes of the latter quality. Such changes might be comparatively easy with the architect who is personally above detail, or who, in other words, is too lazy or too busy to attend to the minutiæ of his own buildings. Street was none of these. He felt profoundly that the whole was made up of its parts, that *ensemble* and detail helped each other; while bad, coarse detail might blur the merit of that which in the rough had been a powerful conception. So with cheerful, unremitting toil he laboured away, not merely at mouldings and foliage, and so forth,

but, like a true ecclesiologist as he was, at furniture, fittings and all accessories, ornamental or practical, in all the various materials, which may be briefly summed up as sculpturing, handling of metals, enamelling the use of crystals and gems, woodwork, textiles, painting on glass or walls, or tablets, or on other varied objects. There can, I fear, be little doubt that he shortened his life by the enormous toilsomeness which he imposed upon himself at the Law Courts in his determination to make them perfect at every point.

The question has sometimes been asked whether such designing of subsidiary features is a legitimate portion of the architect's profession, but I can only wonder at the narrowness which seems to me to prompt the doubt. The architect surely is "*poietes*" and his work a poem; and, as every poet who loves his work strives to make it as polished and perfect as he can in every stanza and every line, so ought the architect to act. Architect, we know, means chief workman, and to the chief workman must belong the direction of all the work. But, perhaps, the architect feels that some one else can more successfully handle these accessories than himself. If so, he is right to give place to that superior gift, but in so doing he so far admits his colleague to a partnership in the poem.

All through Mr. Street's career his fidelity to Gothic was so immaculate that I believe he only twice in any original design strayed even into Norman or Romanesque—in the private chapel for Lord Crawford at Dunecht, and in the Guards' Chapel, where the choice was inevitable. Only once did he ever touch the so-called " Queen Anne " style.

Before I close, I must speak of the latest, and in some respects not the least noble, episode of Mr. Street's life—that of his elevation to the dignity of President of the Royal Institute of British Architects, and his discharge of its exalted functions. The Institute is a commonwealth, and, like other commonwealths, it has its parties and its schools of opinion, both in matters administrative and upon artistic questions. Without such liberty of thinking there could be no life in the body. "Thou hast no tides, poor soulless sea," would be the contemptuous verdict passed upon it. Now no man enjoyed, as I have shown, the luxury of believing his own, and disbelieving other peoples' opinions, to a more robust extent than Street; and so it happened that his election to the Chair of the Institute was not the unanimous tribute at the visible close of a long life to the venerable deserts of the old man eloquent of pencil as of voice, but the result of a healthy party fight to choose the leader who should, as vain man anticipated, arise, in all the power of a life mature and not declining, to hold aloft for many years the standard of his convictions. So Street won by a very narrow majority. But then came the marvel. The shadow, luminous and mysterious, seemed to have been projected. The old mind of the buoyant party man was there, but purged, enlightened, elevated. The impartial care for all that was for the good of architectural men, architectural art, architectural ministration to the welfare of society, as embodied in the Architectural Institute, was the President's duty and delight. Appreciative of all excellence, peacemaker in all perplexities, he succeeded during those few months of office in winning the influence, esteem and affection of all; and in the sad day following quickly on his death, I heard general regrets at the irreparable loss fall from the lips of those who had certainly in past years not mounted his colours.

A. J. B. BERESFORD HOPE.

XVI. THE LATE WILLIAM BURGES, A.R.A., *Fellow.*

By George Aitchison, A.R.A., *Member of Council.*

[Read on Wednesday, 7th May 1884, Ewan Christian, *President,* in the Chair.]

IN 1853, when I was a student in Rome, I made the acquaintance of Captain Drummond at the English Academy. As soon as the season was over he used to give picnics to the English artists and residents who still remained in town. Some place of antiquarian interest was picked out at a riding distance from Rome, and most of the company went on horseback, but there were carriages for those who preferred driving. On one eventful summer morning it was agreed that I should go to Gamgee's stables, with a friend who kept his horses there, and get a mount, but being rather late I found every horse but one gone; this horse had been ordered by a gentleman of unknown name for an hour before, but as he had not come for it, we persuaded Gamgee to let me have it. We joined the cavalcade at the Porta del Popolo, and a few hours' canter brought us to La Storta; while we were waiting for the guide the carriages arrived. A short man, with light, curly hair and spectacles, was objurgating the man who took his horse. I was the culprit, and the objurgator was Burges. However, we settled the matter amicably, and as he preferred going back in a carriage, I had the painful pleasure of returning on the beast that brought me. We examined some of the ruined walls of ancient Veii, and entered the tomb of the Lucumo, whose skull and bronze helmet, pierced through and through with the bronze javelin head, still reposed upon a central slab; the tomb was cut in the rock, the central chamber being domed and adorned with rude wall-paintings, on which Burges descanted. We then discussed our luncheon, and rode home in the cool of the evening. Of that merry company, amongst whom were G. Mason, Poingdestre, Whitburn, Eagles, &c., how few now remain!

I saw but little of Burges in Rome, but I saw and admired his designs for the church ornaments to be used in Sir Frederic Leighton's "Procession of Cimabue's picture." At Sir Frederic's suggestion, Burges and I travelled together when we left Rome; in 1854, we took our farewell of Mount Soracte after the Holy week. We travelled in *vettura,* the lumbering hackney-coach drawn by two wretched hacks that with difficulty drag you twenty miles a day, but this mode of travelling gives you an ample opportunity of seeing the country you pass through, and the towns you stop at. We passed through Sta. Maria degli Angeli, and saw the church, rent by an earthquake, and the miserable inhabitants camped in temporary wooden barracks. At Assisi we made our first long stay; the hotel being full, we stayed at a private house, at the modest cost of 1s. 6d. per day,—our landlady explaining that as we were English gentlemen accustomed to luxury she could not charge less. Poor Burges suffered there from a continued diet of pigeons stuffed with rosemary. After exploring the town, and getting a pair

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of five-foot rods made by the carpenter, we made studies of the painted decorations of the Churches of St. Francis. In our spare time we strolled the town, read Dante and Sacchetti, discussed art, and had our first experience of a slight earthquake. We then went to Perugia, and saw the Sala del Cambio and other buildings of importance; and then took the *diligence* to Florence, discussing the Roman defeat as we passed Lake Thrasymene.

Our plan was to read *Murray* on the way, mark the objects of interest, on our arrival to go up the highest tower and see the town and its surroundings, and then to explore the town, visit the places we had marked, take notes, and measure such things as we thought would be useful.

Burges was then thoroughly versed in the Gothic architecture of England and France, and had come to Italy mainly to study architectural painting and mosaic, goldsmith's work and secular buildings, as he despised the Gothic architecture of the Italian churches. After seeing Florence we went to Siena, measured the Palazzo Tolomei and other palaces, went to San Gimignano delle belle Torre, visited Boccaccio's house at Certaldo, went to Pisa, and, while Burges sketched in the Campo Santo, I measured an old brick palace, then, the Café del Ussero. We then went to Pistoja, measured the Palazzo della Communità and the Paliótto, that splendid altar-front of gilt silver and enamel, made to replace the one stolen by Vanni Fucci* and his friends. We then went back to Florence, measured the battlements of the Palazzo Vecchio, the staircase of the Bargello, and other parts of interest, and here Burges was laid up, and I measured the Palazzo Salviati, went to Prato, and to see some friends in the country, while he designed and had executed a book-cover for Tennyson's Poems. As soon as he was well we went back to Pisa, and saw the magnificent festival of St. Ranieri, which only takes place once in seven years, to commemorate his return from the Holy Land. The crossings of the streets through which the procession passed were carpetted with flowers in patterns, and at night the whole town was splendidly illuminated, so that when we left after midnight for Lucca, Pisa looked like a town of fire. We went from Lucca towards Modena, but where the countries join on the mountains, we were stopped, and found that we must either go back or hire a military escort, on account of the cholera in Tuscany; and though we thought this a curious sanitary precaution, we were half inclined to incur the cost, as we thought our parents would be flattered by our making a sort of royal entry into Modena guarded by a troop of horse soldiers; but economy prevailed over vanity, and we went to Leghorn and took ship for Marseilles, stayed at Lyons, thence to Beaune, where we measured the roof of the hospital. This open timbered roof had been ceiled at the tie-beam and I let down the keys of this loft, tied on to a tape, through a hole in the floor, to see how high the roof was above the stone pavement; their jingling on the stones, and then ascending, was taken by one of the patients for a sign, and we had much bother to persuade the abbess to let us continue our measurements. As we were both in blouses, and black as sweeps, our appearance was not in our favour.

Thence we went to Dijon, where we measured the porch of Notre Dame, and the front of the Hôtel Chambellan. It was arranged between us that we should do no work on fête days, but always take a stroll in the country; but, in point of fact, I do not think we ever did; for,

* . . . . Son Vanni Fucci
. . . .
In giu son messo tanto, perch' io fui
Ladro alla sagrestia de' belli arredi.—Dante, *Inferno*, lib. 24.

before we even reached the suburbs, Burges always espied a by-street that promised to contain some archæological treasure. He had long been anxious to find an example of the red cloth put under pierced ironwork, and in one of the French towns we found a pierced knocker-plate in a back street. He explained the case to the occupier, a smith was found at a neighbouring wine-shop, and the knocker and its plate were taken off, and sure enough under the plate was found a piece of cloth, blackened for the most part, but with a bit of scarlet here and there, where wet and dust could not penetrate.

From Dijon we went to Troyes, and measured part of the cathedral, which was under repair. We then went to Ville-neuve-l'Archevêque, and thence to Sens, where we saw the "Anthropophagi and men whose heads do grow beneath their shoulders" sculptured on the porch of the cathedral, and here we parted,—I to go to Paris, and afterwards back to Italy, and Burges to Chalons-sur-Marne and elsewhere.

During our travels I learned he was born on the 2nd of December 1827, that his father was the well-known engineer of the firm of Walker and Burges, that he had matriculated at the University of London, had attended some lectures on engineering at King's College, that in spite of his father's desires and the splendid prospect open to him if he became an engineer, he was so full of love for antiquarianism and Gothic architecture that he would be nothing but an architect; that he had been articled to Blore, had afterwards been with Sir Digby Wyatt, had sketched in England and elsewhere with Mr. Salter, measured Amiens spire with Mr. Warren, had travelled in France with Mr. H. Clutton, and helped him with the illustrations of his *Domestic Architecture of France*, and that, through the advice of Mr. Bruce Allen, he had determined to measure everything important, and find out its whole method of construction. When I met him he was a rabid Mediævalist, and believed there was no salvation out of the thirteenth century. Sir Digby Wyatt had nicknamed him "Troy," because when it was suggested to Burges that he should make a view of Troy, he said that, in accordance with the custom of the Middle Ages, he should make all the architecture of the thirteenth century.

He was so profound an archæologist that he used to jeer at Blore for declining to give his opinion on the age of a wall because there were no mouldings on it, saying he should have known by the size, working and bonding of the stones, and by the mortar joints, to what age it belonged.

You may easily imagine his scoffs at the Pagan architects of the Renaissance, and his hope that some day "he might make that old wretch, Sir Christopher Wren, turn in his grave." He did, however, allow there was one Pagan architect living that he respected,—Professor Cockerell,—though he added there is so little to learn in the style that the merit is small as compared with learning the Mediæval style.

I have always looked upon it as one of the privileges of my life to have had the chance of being constantly with this genius for so long a period. Unfortunately, biographical sketches of men of thought are necessarily dull; the flame of genius can only be seen in their works, and those workings in the alembic of the mind, by which new products are distilled from the materials provided, are necessarily hidden from mortal eyes; the exact portraiture of the man cannot be given without offence, during the lifetime of the persons to whom he was dear.

The minute, exact and profound knowledge of Mediæval architecture, decoration, furniture, and letters, that Burges had acquired was tempting him to produce a treatise on them for the

use of students, when the publication of Viollet-le-Duc's Dictionary took the wind out of his sails,—perhaps fortunately,—for the publishing architect was turned into the practising one. But we are now speaking of him in the embryo state. He was then one of the most rapid and brilliant draughtsmen I ever met with, and had the most inexhaustible fund of invention; illustrations of literary incidents, designs for chalices, crosiers, knives, scent bottles, comic alphabets, caricatures, Mediæval towns or buildings, came forth from his pen, pencil or brush without a moment's reflection; and although his humour was shown rather by his drawings than by his words, he would on occasion give vent to epigrammatic sentences. "Academies "are the death of art" may be instanced as one of them.

At this time his one besetting fear was lest he should be carried off by accident before he could show the world his genius and his knowledge; his one great hope that he might hereafter partly realise in a house of his own his views of artistic completeness, and no Arab ever had more gorgeous visions than Burges. This visionary house was to be of perfect Mediæval pattern, full of quaint carvings, and blazing with colour, hung with costly stuffs embroidered in gold, and lighted by silver lattices whose storied panes were of cut gems. He was to have jewelled chalices to drink from, and aloe and sandal wood to burn.

Even the castle building of so eccentric a man of genius seems to me to have its value as giving us some insight into those powers he felt himself possessed of and that he most wished to exercise. Well, it was this: he would be first an architect and build a specimen of every ordinary human construction except a cathedral; he would amass enormous wealth, and spend some of it in realising his views in his own house; he would marry; he would, as soon as these varied works were done, become a Member of Parliament, and correct some of the abuses of society; he would then go into the church, become a bishop, and, with his wealth, build a perfect cathedral of the most costly materials, adorned with the most perfect specimens of all the subsidiary arts; and, when this was done, he would end his days as a monk or a hermit.

He returned to England, I believe, at the end of 1854, and I in the spring of 1855; he had then designed a claret-jug and a jewel coffer for a client, and in the same year he entered into the competition, with Mr. H. Clutton, for Lille Cathedral. In March 1856 I went with him to Lille, and saw the competition drawings, and we afterwards went to Tournay. It is said Viollet-le-Duc at first believed that Clutton and Burges's set were some old drawings of the thirteenth century, until he saw "Whatman" on the paper. For once, Burges met his match at repartee, which was no small thing, for, when angered he was like the bee, *ponit animam in punctu.* He was fond of talking to workmen, and was always anxious to know of them how long they thought it would take him, the accomplished architect, to learn their trade. On this occasion we went into the kitchen of our hotel at Lille, and saw the cook, a little hunchback. And after Burges had explained who he was, and that he expected to have the cathedral to build, he asked how long the cook thought it would take to learn cooking thoroughly. "Ah, " Sir, in a fine art like mine one is never master of it; one is always learning."

In 1857 he restored some of the images and designed others for Salisbury Chapter-house, and restored the building, in conjunction with Mr. H. Clutton. He gained the first prize for the Memorial Church at Constantinople in 1859; he designed the cathedral for Brisbane, restored Waltham Abbey, and in 1862 gained Cork Cathedral in competition; altered Gayhurst House for Lord Carington, and delivered the Cantor lectures at the Society of Arts;

in 1864 he decorated Worcester College Chapel, Oxford; in 1865 he began the restoration of Cardiff Castle, and built a house for Mr. McConnochie at Cardiff; in 1866 he designed the School of Art at Bombay; in 1867 he competed for the Law Courts and published a book of his designs for them. In 1869 he built Knightshayes for Sir J. H. Amory, Bart.; and in 1870 he built the church at Studley for Lord Ripon, and that at Skelton for Lady Mary Vyner, and published his book of architectural drawings, containing many of the examples we measured together. In 1872 he began his series of drawings and models for the decoration of St. Paul's Cathedral, London. In 1873 he competed for the Cathedral at Edinburgh, and made the drawings for Hartford College, U.S.; built Templebrady Church, Ireland, and the Speech-room at Harrow. In 1876 he began to build his house in Melbury Road, the internal decorations of which were not completed at his death. His last work was the addition to the Maison Dieu at Dover, to convert it into a Town Hall, since completed by Mr. Pullan.

On January 28th 1881, he was elected an Associate of the Royal Academy, and he died on the 20th of April of the same year. Rarely has any architect been followed to his grave by so many mourning friends, mainly architects from all parts of the country.

A book of his designs was published last year by Mr. Pullan, his brother-in-law.

It seems to me that there are now only three points for our consideration,—the effect of his works and teaching on public opinion, on the younger men of the profession, and the merits and peculiarities of his works. Horace Walpole, in the middle of the last century, advocated the return to Gothic architecture as a patriotic and antiquarian revival, and made rude attempts to apply Gothic ornament and surface decoration to buildings. His notion spread, but it was not till nearly the second quarter of the present century that this antiquarian revival was passionately advocated; and this outcome of late Roman Catholicism was called "Christian," while its supporters poured out floods of obloquy on those who admired or practised any other style.

Augustus Welby Pugin began the onslaught with his *Apology for Christian Architecture*, and the public, who are always interested in a literary conflict, especially if the *odium theologicum* can be imported into it, were easily converted to Gothic, as all forms of beauty were equally indifferent to them, and the advocacy of Gothic supplied them with staple for discussion and abuse. The battle was kept alive by such generals as Sir Gilbert Scott, Street and Burges, and such was the enthusiasm of the first and last for Gothic that nothing but great temptation would make them abandon it. Burges, who was the youngest, ablest and most learned of the three, naturally produced a powerful effect on the public, though by some ill-luck he never got his fair share of the large works carried on. The effect he produced was not a little assisted by his quaintness and pungency of expression; yet in spite of all this passionate advocacy, other influences were at work which silently but surely sapped the foundations of this new Jericho, whose walls at last fell without even the sound of a trumpet. It was generally felt that dignity and simplicity were more allied to our present civilization and turn of thought than Gothic perplexity. For constructive purposes the introduction of iron had superseded the methods used in the middle ages, and the advancing arts of painting and sculpture found themselves too incongruously surrounded in Gothic buildings to be used with effect, even when their highest forms were not resolutely excluded by the architects themselves. The simplicity and matured elegance of form in the higher works of painting and sculpture supplied an inconvenient standard of judgment in Gothic buildings. These

considerations had, however, but little effect on the young and ardent enthusiasts of Gothic, steeped to the lips in the diatribes of Pugin and Ruskin; Burges's pupils and young admirers drank in with undoubting faith the precepts of one who was so enthusiastic, so certain, so skilful, so humorous, and so learned, and they were quite prepared to accept the architecture of the thirteenth century as the ultimate standard of perfection, for were they not always hearing the master say, in criticizing any new work, "I ask myself what a thirteenth-century "architect would have done in this case?"

I never saw any of Burges's designs for buildings that were made before he went to Italy, and while he was there he did not fail to appreciate the grandeur and massiveness of its palaces, and as he absorbed the good from all the Gothic examples he saw, his work for ever after bore traces of that influence. In the same way he was impressed with some Arab forms which he afterwards rarely relinquished. Another marked peculiarity was his fondness for circular forms, and it was rare indeed to find any considerable building in which this fondness was not shown. Nearly all his designs for cathedrals show his preference for the circular end over the square. The Law Courts and his own house show in a marked way this tendency.

His works, or at least those in which his judgment was unfettered, exhibit his predilection for vigorous simplicity; better examples cannot be given than Mr. McConnochie's house at Cardiff, and the Harrow Speech-room. If the Law Courts were to be Gothic we must all regret that he was not entrusted with them, as, in his design, the Strand front was a grand composition, and the proportion of the parts noble. Even Sir Gilbert Scott, a rival competitor, speaks of it thus:—"Mr. Burges, though his architecture exceeded in merit that of any "other competitor, was, nevertheless, eccentric and wild in his treatment of it." How the Government could have passed him over when they had such a genius to their hand, is difficult to understand, and the plea that his plan was bad is well disposed of by Sir Gilbert:— "An able and artistic architect can surely make a good plan, while no amount of skill in mere "planning can by itself enable a man to produce a noble building"—a truth that those who have the disposal of our new public buildings should take to heart.

Burges's skill, however, was by no means confined to pure architecture: his inexhaustible invention was shown in his church ornaments, in the accessories to houses, and in the quaint designs for figures and figure-subjects with which all his works were over-spread. Perhaps the stained-glass windows of his own hall afford one of the best illustrations of his skill and inventiveness in this direction. The subjects are the spirits of Sound floating out of the ringing bells. His devotion to one phase of art may be well recommended to the student; his desire to master all the cognate arts may be pressed on the attention of those whose genius will enable them to imitate him, and we have but two regrets to add,—one, that a man possessed of so strong a personality did not leave an autobiography; and the other, that we have not more of his executed works.

G. AITCHISON.

XVII. THE LATE EUGENE EMMANUEL VIOLLET-LE-DUC, *Hon. Corr. Member*. By Mr. CHARLES WETHERED.

[Read* on Wednesday, 7th May 1884, EWAN CHRISTIAN, *President*, in the Chair.]

BUSILY engaged in another profession, and long enough in sympathy with your pursuits to be sensible of my many shortcomings, it is only by the courtesy of the Council of this Institute that I am now permitted to direct your attention for a short while to some aspects of the life-work of the gifted man whose name will be associated for ever with the architectural glories of France.

I must ask an assemblage like this to accept in a spirit of kindly criticism the scattered observations of an outsider who happens to have seen a good deal of the executed work of the master whom to know was to regard with feelings of veneration and affection.

To this word of self-introduction I may add that I hope my present paper will be supplemented before long by another, entitled "A Fortnight in Switzerland with Viollet-le-Duc," which will comprise a sketch of his striking personality and a further glance at his manifold powers.

Eugène Emmanuel Viollet-le-Duc was endowed with widely-contrasted gifts, only bestowed together in fullest measure on minds of the first order. He was at once an intense realist and an idealist. He possessed the scientific bent for getting at the core of the facts of nature, and he had also the expressional and shaping faculty which can reveal emotional truths through the language of art.

The works of a deceased master are an abiding presence, and in them we speak of him as historically living. In thus approaching Viollet-le-Duc, in his twofold capacity of architect and historian of art, I can do no more now than take a swift run across the "*vrai domaine* "*royal*" claimed for him by Sainte-Beuve, over which he equally holds sway as master of "the "compass, the pencil, the chisel and the pen."

Turning first to two or three of his written and illustrated works which come well within the scope of this Conference, I will then pass on to speak briefly of the artist who creates of himself, and who also brings the buried forms of the past back to life.

Art with him was a strong instinct from his very cradle, and his family surroundings were well fitted to nurture the growth of a child of genius. His father was a man of mark in literature, and his uncle, M. Délacluze, an artist of distinction. Every week at the house of one or the other he met some of the most gifted intellects of France. At these *réunions* he made, in his earlier years, the life-long friendship of Thiers, Rémusat, Mérimée, Ampère, Villemain, Stendhall and others known to fame. Always on the alert, we may be sure the repective mind of young Eugène assimilated innumerable ideas from listening to the best

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* At the Fourth Meeting of the General Conference of Architects held in London from the 5th to the 9th May 1884.

literary and philosophical talk of the day. His education had a breadth and thoroughness by no means common fifty years ago. It was completed by more than one lengthened stay in Italy, and supplemented by a course of dissection at one of the medical schools of Paris, in order to obtain a practical knowledge of anatomy in relation to external form. Always self-reliant, by the time he was eighteen he had made more than enough pocket-money by his water-colour drawings and modellings to buy himself a horse, and with this helpful companion the young enthusiast in art made the first of a series of journeys which enabled him to visit, measure, draw and describe the chief ecclesiastical, military and civil buildings of the Middle Ages over the greater part of France. Here the boy was father to the man, and the immense mass of materials thus collected in his youth laid the foundation of his *opus magnum* so well known to you, the *Dictionnaire raisonné de l'Architecture Française,* followed by its complement, the *Dictionnaire raisonné du Mobilier Français,* forming together sixteen volumes, illustrated by nearly 6,000 engravings, finely drawn on the wood by himself. For the archæologist and student of history these volumes unlock the vast treasure-house of the Mediæval world. Given a building of ancient France,—to take an instance of the thoroughness of his insight and teaching,—he is not content with settling the date, describing the external characteristics and determining the style or school; but, if I may apply surgical terms, he submits it to careful dissection, and rewards his readers with the knowledge of its anatomy and physiology,— the structure of the whole, and the functions of its various members. Unfolding its origins, he presents it as a product of evolution; as a more or less perfect type of a phase of development; and as the logical expression of the needs, customs, aptitudes and aspirations of a people and period.

Mr. Street has gracefully acknowledged his leadership in these researches in his *Gothic Architecture in Spain*:—" M. Viollet-le-Duc's articles in the *Dictionnaire raisonné,*" he states, " on the planning of French churches, are extremely valuable, as indeed is all that he " writes; and I take the opportunity afforded me by the aid which he has thus given me to " express the gratitude which, I suppose, every student of Christian art feels for what he has " done towards promoting its right study."

Not a few of the 800 articles are complete essays: that on mural painting, according to M. Véron, editor of *L'Art,* " is a veritable treatise on chromatic harmony by a man thoroughly " master of the subject. It contains a multitude of facts as interesting as they are little known."

Prosper Mérimée, in a learned review, extolled alike the prodigious fecundity of the writer and the force and finish of the draughtsman.

His " Lectures on Architecture," so ably translated by Mr. Bucknall, twenty in number, are a *résumé* of his doctrines generally. This critical interpretation of man's graven dialect in the monuments of the past is a philosophy of architecture, and within its compass a philosophy of history itself. To myself, a simple searcher after the beautiful, with vague notions of art, it came as the revelation of æsthetic truth. I believe it to be the book of all books for obtaining a wide outlook over the world of man's handiwork—over that combination of the arts which gives architecture vitality and voice. This treasury of facts and ideas, of axioms and apophthegms, is an authoritative code of arts, of laws bearing upon their kinship and interdependence, upon what they are in themselves and in relation to each other. The depth and range of his acquirements are not less conspicuous than is his aversion to dogmatism and

exclusiveness. Bringing the analytical method to bear upon his investigations, he verifies his conclusions by synthesis. He resolves the work under review into its essential elements, tracing the latter back to native instincts and gifts. He shows how these elements are severally combined by the Greek, the Roman and Mediæval builders, and how, by bringing principles into harmony with form, they have left us diversified types of the everlastingly true and beautiful. To the neglect of these fundamental principles he ascribes those hybrid productions of modern times, Neo-Greek, Neo-Roman, Neo-Gothic, which defy classification—"A medley of styles, fashions, epochs, and means of construction."

While frankly recognising all that makes for excellence in the work of man's hands, Pagan or Christian, his best sympathies are with the mediæval schools of France, so rich in all ministerial arts, and unrivalled for the inventive skill, picturesque arrangement, and soaring grandeur of their buildings. These prolific schools, so truly national and original,—whose traditions had been ignored with a strange forgetfulness of the past in the pseudo-classic system of instruction initiated under Louis XIV,—he has explored with a penetrating clearness of vision as rare as it is admirable.

No writer has dwelt more ably on the nobler side of architecture as an expressional force among races and nations. With a pencil as eloquent as his pen we see as in a mirror, by the fresher light of his reading, how hewn and chiselled stones tell their pathetic tale of human effort and yearning. In these, his tracings of the landmarks of history, we often come upon ethical and political precepts weighted with the higher wisdom of a seer shackled by no party or prejudice. To disentangle the true from the false in all that concerns the common weal of the arts is the golden rule that runs throughout the writings of this loyal and untiring worker for his fellow men.

At an influential meeting in Paris, held after the close of the exhibition of his works at the Musée de Cluny, it was resolved to reproduce by the best technical methods a selection from his drawings, representative of his range and manner generally, including many examples of detail in relief section or profile, as they flowed from his hand for execution by his school of artists and craftsmen. A sum of several thousand francs was at once subscribed, and a committee formed for carrying out the project in a way worthy of "*le grand patriote et le grand* "*artiste.*" The resulting portfolio of *Compositions et Dessins*, just given to the world, is at once a monument of his creative versatility, and the fittest memorial of an architect ever raised by his *confrères* and friends. In these facsimiles the accent of the master is never missing—in his unerring firmness of touch, truth of line, and fine sense of form, in the calm dignity of his statuary, and in the life and vigour of his ornamentation generally. In his constructive and decorative designs we discern unity amidst plurality, combinations of the grand and the simple that result in a style of distinction with lucidity, so that he who runs may read the *raison d'être* of every detail.

Whatever the scale or subject may be, whether designing a reliquary to be worked by goldsmith or silversmith, or planning a vast cathedral front, with its eloquent chapter of sculptured harmonies, like that of Clermont-Ferrand, we everywhere perceive the impress of a master-hand.

His figure-subjects and carved work generally, "Cornice or frieze with bossy sculptures "graven," as well as his wall-paintings, are essentially monumental, and decorative in the true

sense,—*en rapport* with their surroundings, from which they cannot be detached, even in drawings, without our losing something of their full effect. A true architectonic chord is struck by this intimate union of the arts in the general scheme of representative design, delighting the eye as a symphony delights the ear.

Who has not loitered to observe his happy and often grotesque renderings of animated nature, in beasts of the field and fowls of the air, that catch the eye of the passer-by from every coign of vantage outside the cathedrals of Rheims and Paris, not to mention endless other examples of his humour in this vein to be met with here and there throughout France? Whether wrought in stone, wood or iron, they exhibit a singular mastery of animal configuration and gesture, with a facile fertility of production that never repeats itself. Thousands of these, replacing originals long lost, are re-creations rather than reproductions.

Very notable, too, are his adaptations of the facts of plant growth, displayed in a very world of bud, leaf, flower and fruit, with a subtlety of curved line and dash of manner that always charm the spectator. "Joy's soul lies in the doing" of such work.

The revival of the higher art of the coppersmith and leadbeater in connexion with architecture is largely due to his plastic handling and teaching. As surpassing examples of the handiwork of the former, I may instance the statues grouped around the *flèche* of Notre Dame, and the figure of St. Michael crowning the chapel of Pierrefonds Castle; of the latter, the crestings, crockets, finials, &c., on the adjoining roofs.

To this phase of his genius we owe his achievements in a sphere and period which Mr. Hamerton, in his interesting History of Autun Cathedral, has named "the epoch of Viollet-le "Duc,"—the sphere of architectural restoration.

Restoration is an impulse of our day to conserve the good bequeathed to us in every architecture, and to undo the misdoings that have degraded or obscured earlier and better work, paying due regard to later additions of exceptional worth. It is to give a building, whose constitution has suffered from age or injury, a renewal of life, by treatment adapted to its peculiar temperament.

Viollet-le-Duc's grasp on the past, the logical bent of his mind in the observance of principles, his wealth of ideas and ability to give them shape, have made him *facile princeps* of Continental restorers. His ideal restoration of the Baths of Caracalla is as vivid as that of the Château de Coucy on paper, or of Pierrefonds in fact.

A lover of unity amidst infinite variety, the marvels of the Middle Ages were to him well-ordered organic wholes,—the embodied ideals of their framers or of successors inheriting their instincts,—and not as they have too often become, at the hands of latter-day meddlers, a *mélange*. Order, "Heaven's first law," was theirs and his. They solved their problems in stone by mathematics, and enriched their constructions with shapes and suggestions gathered from living nature in field and forest around.

Having given, however imperfectly, some notion of Viollet-le-Duc's spirit and method, but short space is left for me to ask you to accompany me in thought to a few of the more famous buildings upon which he has lastingly set the sign manual of his art.

Monsieur de Baudot, an accomplished disciple of his master, and now an Inspector-General of Historical Monuments, has, through a friend, honoured me with a note in point well deserving, I think, of being read to you. He writes :—

"Viollet-le-Duc began in 1869 the interesting work of completing the Cathedral of "Clermont, *i.e.*, two bays of the nave similar to those already existing, also the two towers and "the principle façade. For the façade and these towers he had no other data to work upon "except substructions, the cathedral having never been finished at this point. There were, in "fact, only foundations, and he had to conceive a design, that is to say, to create the work in "question. Availing himself of the experience of the Mediæval masters, without tentative "effort he created at a stroke that grand composition,—façade and towers; and I do not think "there exist in the Mediæval period towers or spires of finer outline, or more skilfully planned "in point of construction. It will be understood that this work, like the rest of the cathedral, "is executed in the style of the close of the thirteenth century. Nevertheless, in the ornamen-"tation and in the outlines we find a character of simplicity which belongs especially to "Viollet-le-Duc, who did not copy, but interpreted the Middle Ages by drawing his inspiration "from nature as regards the flora, fauna and statuary.

"In the execution itself Viollet-le-Duc conducted only a part, and when he relinquished "his post as Diocesan Architect in 1874, the work was carried up only as far as the top of the "nave. At this time I was commissioned to complete it, and consequently to supply part of "the details of execution, but I did my best to interpret as completely as possible the master-"thought which had designed the whole, and had supplied details of every kind for the greater "part of the work, the honour of which belongs entirely to him."

The church of the Benedictine Abbey of Vézelay is the most imposing remnant left of that great school of Cluny which had so marked an influence in Burgundy, and, as we learn from Viollet-le-Duc, over Christendom at large. In 1839 it presented, from long and general neglect, an aspect so forlorn and threatening that it became a question with the authorities whether its fate should not be settled by a *coup de grâce.* The loosened masonry of its Romanesque vaulting that for 600 years and more had spanned the nave, with a grandeur hardly to be seen elsewhere, rested on toppling walls ready to fall at the first stroke of the hammer. Mérimée, then Inspector-General of Historical Monuments, was one of the first to recognise the practical genius of Viollet-le-Duc, at that time an untried architect of five-and-twenty, and to him he entrusted the important task of its preservation. It was the starting-point of his career as a conservator of things of the past. He was wont to speak of it as his *premier amour.* The fruit of that first love is a finished edifice as strong as when built by Clunisian masons in the twelfth century. Left to the tender mercies of those doers of nothing who are opposed to all restoration, this ancestral monument, seen again to-day in all its perfected strength and severe beauty, would have become ere this a huddled mass of ruins,—*rerum confusa sine ordine moles.*

Shortly before his labours at Vézelay he was engaged under Lassus in resetting that architectural gem of purest ray serene, the Sainte Chapelle of St. Louis.

"Many-towered" Carcassonne is an ancient and mighty stronghold of Languedoc, which every tourist in the Pyrenees who loves the past should step out of his way to see. It is in all ways the most perfect example remaining of the system of military defence that prevailed in Europe from the eleventh to the fourteenth century. Within the citadel may be seen the various implements of war, used through the ages swayed by the baron and the monk, which have been restored or constructed by Viollet-le-Duc, whose genius as a military engineer has

been fully recognised by authorities on both sides of the Channel.* With its restored belongings, it is much in the same state as when, "in 1356, this fortress effectually resisted the "Black Prince, who burned the suburb below, and ravaged with fire and sword the whole of "Languedoc."

The Romanesque church of St. Nazaire, with the ramparts, is well called by Murray "a perfect gem of architecture, and unlike anything in France." Less than thirty years ago it was all but a pile of ruins. The vaulting had fallen in; the walls were cleft and rent; the stained glass, in brilliancy and glow of colour equalling that of Chartres, was broken and detached. Here again his reshaping hand has

> "Soften'd down the hoar austerity
> "Of rugged desolation, and fill'd up,
> "As 'twere anew, the gaps of centuries."

The Château de Pierrefonds, with its encircling towers, donjon-keeps and chapel, dismantled and in great part destroyed at the beginning of the seventeenth century, has risen again with not less outward strength and interior splendour than when it dominated the Forest of Compiègne in feudal times. This baronial palace and fortress in its renovated state is a series of deductions in stone by the Cuvier of architects, who re-clothes the disarrayed structures of bygone ages with the vesture of his art. Sections of mouldings and other fragments rescued from the carefully-sifted *débris* are here and there replaced *in situ,* and give the key, as it were, to neighbouring details. In this restored page of the historical arts of France we find a pervading unity,—a concord that comes of the sense of fitness where all things are in keeping, an *ensemble* which earlier schools possessed, but which in the chaos of our modern means and materials we have to a great extent lost.

At almost every turn we meet with some historic personage, some hero or heroine of romantic story,—impersonations linked with old-world beliefs and lofty ideals not altogether without power to stir the emotions, even in times "at war with old poetic feeling" such as ours. His chief sculptor at Pierrefonds, M. Guadran, told us that he sometimes found it wellnigh impossible to translate into stone all the *finesse* of the master's drawings, pointing out the exquisite statue of Joan of Arc, in its canopied niche over the entrance to the great hall of reception, as an illustration.

It would seem that when a building has gone to the bad some of our notabilities in the republic of art would leave it as a dwelling for rats and carrion birds. From its relevancy to this part of my subject, I will presume to call their attention for a moment to what Frederick Schlegel says of the Abbey Church of St. Denis, when he beheld it in 1804 as wrecked by the Revolutionists:—

"The deep silent melancholy it inspires becomes stronger and more profound in "approaching this ancient and now ruined cathedral. Every part that could be destroyed "without too much labour and difficulty has been thrown down; the naked walls alone are "left standing with the massy pillars and the arches that rest upon them. As the doors were "opened a host of jackdaws and rooks, the sole inhabitants of the desecrated sanctuary, took

* See the very able review of his *Mémoire sur la Défense de Paris;* also of his *Annals of a Fortress,* in *The Times* of Nov. 19 and Dec. 22, 1875.—C.W.

"flight, and when the dust they raised had subsided, we saw the upturned graves of the "sovereigns of France, each of which the verger carefully pointed out."

To the critic whose own mood of mind is the measure of excellence in art, St Denis may be a "whited sepulchre;" but posterity will have cause to thank Viollet-le-Duc and his band of skilled artificers for the renewed completeness throughout of that noble fabric,—for the restored tombs and effigies of a long line of kings, not so very long ago lying mutilated and scattered over France. "Look on this picture and on this,"—contrast St. Denis as ravaged by the iconoclast, with the Church of the Patron Saint as we see it to-day, and who but lovers of decay and *débris* will doubt the lasting good done by men working in the spirit, and following the methods of the old builders?

The learned German critic also describes the condition of Notre Dame at the same date, as follows:—"During the first Revolution the front was injured in various ways, the exterior "being despoiled of its decorations and the statues torn down and destroyed. Worse than all "this is the injury which the interior has sustained by absolute mutilation. The clustered "pillars supporting the roof have been filled in, rounded and modernized as much as possible, "so as to give them the appearance of solid circular columns The effect thus produced is "completely inconsistent with the plan of the exterior . . . . An intolerable spirit of "persecution in the arts was often seen united with that inclination to imitate the false "antique, which seemed epidemic in the eighteenth century."

Certainly man's rage outside, and the flaunting spirit of the Renaissance within, had done much to damage the aspect of the Church of Our Lady at Paris. The removal of the worst of the incongruities of later times, "the pomps of Louis Quatorze and the vanities of Louis "Quinze;" and the added embellishments of Viollet-le-Duc, have brought about the harmonious change most of you have seen.

Stript until lately of much of its iconography, the onlooker now perceives how, by one supreme directing hand, this venerable metropolitan temple has become re-animated with presentments of the sacred hierarchy, in mural paintings, zones of statuary and other allied adornments.

His works there culminate in that embodied conception of a tradition and aspiration, the new central spire or *flèche,* a masterpiece of scientific framing within, and an artistic thing of beauty pointing heavenwards without. At its base stands the statue of the great architect, not "in his habit as he lived," like the one just erected on the front of the Hôtel de Ville, but, as befits the place, in the costume of a mediæval master-mason. It is of hammered copper, wrought by his metal-workers, and placed there as an enduring mark of their homage and profound respect. The art of the modeller and the science of the geometrician are also blended with happiest effect in the new baptismal font of bronze. So fine and bold are the figured reliefs of saint and symbol in this superb casting, that it is only by examination of the working drawings we notice how the freedom of the one in sweep and emphasis of modulated line is regulated by the applied laws of the other. Here, as in his works elsewhere, the artist and the man of science stand side by side. This duality is the note of his individualism, and the mental groundwork of his strength in the realm of imagination and in the world of fact.

And now, as the passing minutes warn me I have claimed more than my share of your kind attention, I will add my concluding word.

None know better than yourselves, gentlemen, that a new architecture is the product of the combined effort of at least several generations; never the creation of one man. Viollet-le-Duc was not the maker of a new style: he did not attempt the impossible; but he has laid down with all the weight of his logic lines of direction for the path of the future. We must proceed, he insists, not by imitation of forms, but by deduction of principles, aided in their application by all the lights modern science can bestow, if we are to possess a constructive art worthily expressive of our age and civilisation. M. de Baudot maintains, with the ardour of a follower, that this programme can be best fulfilled by a serious study of the "thinker and "worker," whom he designates "*le chef de l'école de l'avenir.*"

The scientific or other specialist may here and there in his own groove find something open to objection, but, taking the illustrious Frenchman all round, as a theoretical and practical architect; as an art-historian bringing the light of the past to illuminate the present; as a matchless teacher, in the workshop and in the studio, of arts which are the sisters, and crafts which are the handmaids, of architecture, he stands foremost as "*l'homme du siècle,*"—the man of the nineteenth century.

CHARLES WETHERED.

XVIII. ENGLISH ARCHITECTURE THIRTY YEARS HENCE.

By Professor Kerr, *Fellow*.

[Read* on Friday, 9th May 1884, Cole A. Adams, President of the Architectural Association, *Member of Council*, in the Chair.]

THE question I am requested to submit is one that has a certain particular and practical importance just now:—What is the line upon which the profession of architects is moving in England? In other words, what is likely to be the position of English architects, say, thirty years hence? I am expected to confine your attention to the artistic aspect of the question, but to regard it in a practical light.

Now we pretty well understand in these scientific days that all continuous enterprises of human industry or skill, or of social or intellectual activity, when looked at in any degree under the surface of affairs, are found to be subject to the government of certain laws of progression; so that it is the critical study of the past that becomes the only means of forecasting the future. In the arts more particularly is the fact forced upon the notice of thoughtful observers that there has been a continuous current of development gliding through all the ages in one grand inevitable course: now in the sunshine, now in the shade; here swift and strong, there feeble and sluggish. But always the same: the same springs, the same issue; great men and great successes,—and great failures with them,—being but the greater bubbles on the surface of events, and even the humblest of workers adding every one his indispensable contribution to the tide.

Amongst the arts of which I venture to speak in this high tone, I may at once say that I regard architecture as one of the very greatest,—perhaps, indeed, beyond dispute, the most subtle and most glorious of all. It is nothing to me, standing before an assembly like this, if I should be told to moderate my language, and to ask you to veil your faces before the painter or the poet. I do nothing of the kind. I ask you, rather, to look back along an expanse of magnificent building, whose length is not to be measured by furlongs or feet, or its area by acres, but its unbroken continuity by the very ages of history, throughout at least 5,000 years, and in whose earliest and crudest works, such is the inherent majesty of the art, Queen of the Arts, the noblest of mankind aimed at never less than the noblest homage to the noblest conceptions of the Divine.

Along this splendid line of artistic manifestation we see exemplified, more clearly than in almost anything else that philosophy can quote, the operation of the process now known by the name of evolution. The simplicity of it is, indeed, perfect. Given the desire to build in beauty,—nothing more,—and the whole scheme of architectural history throughout the past is understood; and the persistent sequence of the self-same scheme throughout the future too. Out of the desire there comes at once a continual endeavour after novelty, the diversity which supplies the material for selection. That which is worthy is reproduced, that which is not is not, and hence arise schools and styles, in the most direct and palpable form, by the survival of the fittest. Thus it is that the study, the very studentship, of this art becomes so essentially bound up in the past; for no training worthy of the name can stop short of a review of the whole historical scheme of development. And thus it is again that the progress of change in this art appears to be so slow, the limits of even the most eager originality so narrow, and the disappointment of the too ambitious so complete.

Therefore, if we would try to understand our own position just now as representatives for the moment of this great art in England, and to foresee the attitude of our order in the next generation, the easiest mode of procedure,—perhaps the only one,—is to begin a generation back, and so work forward to the present day, in the hope that our research may acquire momentum enough to carry us still forward a little way into the future.

About fifty years ago, then, there happened certain occurrences which make the period a great landmark in English architectural history. In 1834 there was founded our professional guild, now so well known as the Institute of British Architects. In 1834 also the old Houses of Parliament at Westminster were burned down. The foundation of the Institute, and its incorporation by royal charter shortly after, indicated the arrival of the profession of architects in England at a significant stage of development and of organization. The

* At the sixth and final Meeting of the General Conference of Architects held in London from the 5th to the 9th May 1884.

destruction of the important edifice which had accommodated the business of the Legislature afforded an opportunity to that profession to enter upon a new career. The accession of the young Queen Victoria in 1837, involving the inauguration of a new national spirit, may be regarded as one more, and perhaps the chief, in this group of events; and if we further include the advent, within a short time afterwards, of Her Majesty's most admirable Consort, as an ally to the great cause of culture,—and more especially as regards our present purpose, with reference to the splendid new Palace of Parliament, by that time waiting for just such help as his,—we see, clustered within the compass of half a dozen years, a concurrence of circumstances by which there is constituted with remarkable precision just such a point of departure as we desire.

Let me remind you of the somewhat analogous combination of events under which English architecture started on a new line of development in the latter half of the seventeenth century: the overthrow of the gloomy Puritan ascendancy, the establishment of a new and brilliant royalty, then the disaster of a great fire —we will call it the burning of the Cathedral of London—and the rise of a great architect. So also at the time now before us we have, in the death of William IV, and the accession of the youthful Victoria, the old worn-out Georgian philistinism going down at last, rude and dogged as ever, and another social system arising, entirely new and bright, the hope of the world; and therewith another great fire, and the rise of another great architect. I am accustomed to speak of Wren and Barry as the two great architects of modern England, in whose especial eminence there is as yet no third great architect quite entitled to claim a share. With both of them alike, everything their hand touched seemed to turn to a certain personal graciousness of form not easily described or accounted for; neither of them, perhaps, attaining to the ideal which we are beginning to conceive of the perfect master of our wonderful art, with whom mechanical science and æsthetic grace advance hand in hand from the sketch to the consummation; each of them, indeed, in his degree very notably a designer of superficiation, if the truth must be told, but both accomplishing that superficiation with an infinite success of elegance altogether his own artistic quality. From the Great Fire of London, that is to say, and the career of Sir Christopher Wren to the burning of the old Parliament House, and the career of Sir Charles Barry, there extends a period of English architectural history which represents the whole development of popular Neo-Classicism, from its rise to its fall; from St. Paul's Cathedral and Greenwich Hospital to St. Pancras Church, the National Gallery, the British Museum, the Club-houses, and the plaster façades of the Regent's Park; when it was time at last that some change should come; and, if only as an enigma for your consideration, I think I see at the very beginning of this manifestation and at the very end the two most conspicuous masters of the situation, with no equal between. Perhaps I may go on to remark, as a coincidence, that from Barry's day to our own there extends the course of another remarkable architectural development, with its most powerful and characteristic exponents again at the beginning and at the end, Pugin and Street. I commend these circumstances to the curious: at the moment when Barry in his Club-houses offered us a new version of Wren's Classic, we threw it over and reverted to Gothic; and at the moment when Street in his Law Courts has brought Pugin's Gothic to supremacy, we now cast that aside and return to Classic. Such is the play of action and reaction: art is a long story, but its chapters are short.

At the commencement, then, of the Victorian age in which it is our privilege to live, this was the condition of architectural art in London. Sir John Soane, in old age and retirement, was the efficient representative of the best commonplace Greek taste. Cockerell, his successor in the professorship of the Academy, was the much more brilliant and accomplished exponent of the higher theoretic level of the same school. Smirke and Hardwick, on the lower ground of mere successful business, were of still the same order of designers. Wilkins's National Gallery and University College had been produced as exemplars of what Anglo-Greek ought to be, and had failed to secure the popularity expected. Barry,—whose age was under forty when he stood on Westminster Bridge staring at the conflagration of the Parliament House, and dreaming inexpressible dreams, —had designed his two club-houses in Pall Mall in a novel mode, and had received the applause which had been denied to Wilkins. I need only add that at the newly-established Institute, Tite, as a representative of the rude energy of a prosperous commercial practitioner and an adherent of the convenient abstract eclecticism of the thorough man of business, divided the leadership with Donaldson, most indefatigable writer and speaker, to whose entranced intelligence the study of architecture was a worship, and its miraculous origin in far antiquity a faith that never could be shaken. The extreme refinement of the state of opinion which I have thus indicated was endowed with shape and purpose by the Society of Dilettanti, under whose authority the latest and most characteristic enterprize of a long series was undertaken a few years afterwards by Mr. Penrose, in his elaborate admeasurements of the optical corrections of the Parthenon, the supreme and final outcome of a system of criticism which the world can never now be at the trouble to revive.

The inevitable operation of the natural law of reaction and revolt had meanwhile been producing in many minds a feeling of antagonism to this attenuated and traditional Classic. Romanticism, in short, of the more robust order had begun to despise criticism so effeminate and so frigid. Now, English romanticism takes two forms: ancestor-worship and ecclesiasticism; and in both of these forms a change was coming over architecture. The Oxford movement, or High Church movement, or Mediæval revival,—call it which you will,—was acquiring force in the Church; whilst, as regards the State, no sooner was it understood that a new palace of the Legislature was to be built on a grand scale, and that Sir Robert Smirke, as one of the standing architects of the Government, had been commissioned to prepare the design for it, than members of Parliament began promptly to agitate for a patriotic adoption of what was then designated the Baronial style,—"Gothic or "Elizabethan" was the phrase eventually accepted,—and for the transference of the architect's retainer from the hands of the prosaic Smirke to those of some unknown romanticist, who should be selected by means of a public competition. Barry won the prize; and at the present moment, when an enthusiastic belief in the virtues of competition has been revived, in the hope that "fair-play" will cure all evils (and fair-play seems as coy as ever in answering to the call), it is interesting to remember that the fairness of the selection of Barry's design was never challenged by any criticism more severe than this,—that the favour of influential friends at court had not been refused, and that the ablest specialist assistance had been wisely secured.

The adoption of this design for the new Houses of Parliament consummated the Gothic revival. The baronial idea instantly took the fancy of the public; it formulated an innovation, allayed a disquietude, and satisfied the demands of a genuine reaction. Churches, it was true, had been built for some time in various kinds of pointed arcuation; Castles also had been built for patriotic squires, even by Wilkins himself, with Gothic arches of no particular form, and some of them with Gothic cannon,—cannon of wood frowning ornamentally from embrasures of stucco; Cathedrals also had been restored by the help of cast-iron and compo; and London dining-rooms had been ingeniously adorned with tracery cut out of thin deal, and grained and varnished; but now all this was to be improved upon. Pugin fulminated his anathemas against everything that was spurious, everything that was pagan, everything that was modern; even the dainty engravings of Britton and Le Keux's cathedrals were supplanted by the masculine lithographs of a new school of travelling sketchers; Ruskin arose, as the prophet of a mysterious gospel unknown to the multitude; and England found itself at the commencement of an incomprehensible architectural civil war.

The contending parties gradually organized their forces. One called itself the Gothic party; the other the Classic party. There was a third, stronger than either in all but enthusiasm, which called itself the Eclectic party. At first, indeed, the Gothicists, like all originators of revolution, had to content themselves with the pleasures of hope, and to console themselves with the exercise of scorn. England is the home of compromise, and it was at length agreed that Gothic should be recognized as the proper mode for churches, Elizabethan for country houses, and Italian Classic for municipal buildings. It was agreed also that every individual practitioner should be permitted to do his best in all three styles, or, indeed, in any other he pleased, and to claim the respect of the world for so doing. Cockerell, in his Royal Academy lectures, pleaded earnestly for what he called catholicity, or universal forbearance. Donaldson, at the Institute, consented to accept the supernatural, to a reasonable extent, in Gothic as well as Greek; Tite had already actually taken a lead in Gothic design by his Scotch church in Regent Square; but, strange to say, Barry, the accepted prince of the practical revival, was at heart its enemy. I believe it is quite understood that, if the Government could have been persuaded by him, the Palace of Westminster would have been built after all in the stately style of the Italian Renaissance. I ought not to omit to mention that at this time the architectural press, as we now understand the term, may be said to have been founded. I allude, of course, to the establishment of the first of our weekly newspapers. Previously, the *Civil Engineer and Architect's Journal*, a feeble monthly magazine, was the only organ of the profession, and necessarily one of very imperfect influence. The progress of architectural and engineering journalism separately, since that day, I need only say, has been most satisfactory; and I cannot help alluding especially to the remarkable development of the weekly illustrations of English architectural art, which cannot fail to be of immense artistic value throughout the world.

The year 1848 soon arrived. I need only remind you that it was a year of European revolution, out of which France, throwing off once more the embarrassments of tradition, entered upon a new and strange national career. For two hundred years Paris had been the focus of artistic culture, but of late the vivacity of the people had scarcely been seconded by the example of the Court. The Government now passed into the hands of a peculiar class of adventurous men of affairs, determined to purchase unlimited power for themselves at the price of unlimited luxury for the people. The arts do not inquire too closely into the character of their patrons; and whatever others may have to say of Napoleon III, architects must always hold his memory in

honour for the artistic brilliancy (to say nothing of political wisdom) of the architectural operations which he so successfully conducted.

English architecture had not hitherto sought for inspiration in Paris. Neither, indeed, does it now, and I venture to think it never will ; for, vastly as I admire all French art, I can never divest my mind of the feeling that I am admiring something whose charms are feminine. I say, therefore, that England, the very home of rough-and-ready musculinity, will probably never follow the precise formulas of French taste. But it was impossible that the new start which the French were making in social display in 1849 should fail to exert an influence upon English art in one way or another. The inauguration of the great system of international exhibitions brought this influence into play ; and the years 1851 and 1855, taken together, produced a crisis in English architectural history which is now seen to have been almost more notable for its results than any other incident of the kind in modern times.

When the Exhibition of 1851 was opened, our professional world stood thus. The Prince Consort, now at the enterprising age of thirty-two, had become an important agent in the progress of general culture in his adopted country. It was soon understood that he had a considerable respect for architectural work, but that he had not the same regard for English architects. Perhaps this was partly due to the fact that the criticism of artistic building was in the confusion I have lately described, and that it occupied indeed what must be be called low ground, a sort of unscientific squabbling ground to which a high-class German intellect might scarcely see its way to descend. Amongst the public duties which had come to be imposed upon him, one of the most prominent was the administration of the artistic completion of the new Houses of Parliament ; and we may suppose him to have thus become deeply impressed with a sense of the tradesmanlike condition (if the phrase may be excused) in which he found popular English architecture and its auxiliary arts as a whole ; a quality which is now candidly recognized as having been only too forcibly manifested in those days. I do not wish to attach to Prince Albert the character of a personal leader,—it would be false criticism to do so ; but I think he was a particularly good representative of an impending change in the public intelligence of England ; and it is no doubt the fact that the very peculiar unpopularity of the profession of architects, which, during the last fifteen or twenty years especially, has been so frequently exemplified to our cost, took its rise in the early days of the Prince's intervention in architectural affairs. The standard-bearers of the day, let us remember, were Barry and Pugin, Ruskin and Fergusson, Scott,—or rather Scott & Moffat,—and Donaldson and Tite at the Institute. Barry's work at the Houses of Parliament was advancing tediously and mysteriously, and a sort of philistine grumble against it was constantly being heard in the House of Commons, as if the architect and the legislature were not pulling together. Then Pugin, as the exponent proper of the Gothic Revival, although acting as Barry's very loyal ally in the great work itself privately, was, in his public capacity, simply a frantic enthusiast, whose fanaticism for the Mediæval, in season and out of season, that and nothing else, made confusion worse confounded. Of Ruskin, again, one can only say,—and all the more confidently now that he has in age turned against himself in youth,—that the specious, reckless, often meaningless rhetoric of his charming writings stirred up a vague and spurious sentimentalism, which, without benefiting architecture, was doing infinite damage to the architect. Fergusson, next in order, although as dogmatic as Ruskin, was as prosaic and cool as Ruskin was poetic and impassioned, and as well disposed to the working architect as Ruskin was scornfully inimical. But he cannot be said to have helped the profession, by his very considerable services to the art, so much as he unconsciously disparaged in the eyes of the public an order of artists who required an amateur to teach them. I have next mentioned Scott & Moffat. For the moment I do not see the great ecclesiastical designer of a later date, but only the firm of reckless public competitioners, in whose hands the abuse of a practice, always signally open to abuse, had already attained dimensions which could not fail to bring down sooner or later a dignified æsthetic profession to the level of a grasping trade. Much as I revere the memory of Sir Gilbert Scott, I feel that I should be false to my duty at the present moment if I were to hesitate to blame him, and his too clever partner of forty years ago, for their introduction of a mode of struggling for work at any price, which I believe to have done an amount of injury to English architects only less than that which, I am sorry to say, I think it has yet to do. I have spoken lastly of Donaldson and Tite at the Institute. Of Professor Donaldson, I need only say that so far as a high-minded and fearless maintenance of the lofty character of our splendid art and its literature, and of the honourable historical position of our artists, antiquarians, and critics could defend us against assault, whether vulgar or refined, he never for an instant swerved from his duty as leader of the guild ; and of Sir William Tite, although a man of very different qualities, I am glad to say, from personal knowledge, very much the same. By this time, I may add, Professor Cockerell, who never was wanting in courage to champion the cause of his order, could scarcely be called upon to be more than a looker-on.

I must now speak of that remarkable man, Henry Cole, whom I regard as having taken an exceedingly earnest and effective lead in the change that was coming over English art architectural. I use this term—*art architectural*—in order to suggest to you an important practical distinction between the academical *architecture* of the period preceding 1851, and the non-academical *architectural art* in general which then began to take its place,—a whole galaxy of constructive, formative, decorative, and industrial arts being now in question, amongst which the pure building-art of old traditions was but the central star.

Cole had for the work of his life the advancement of what we have been accustomed to call the minor arts ; and there can be no doubt that he began upon the basis of a personal dislike to the professional practice of architecture, which he maintained to the end and bequeathed to his successors. Rightly or wrongly, he seems to have arrived at the conclusion that the architect was a fossil, whose functions in the streets of ancient Rome, or in the cloisters of Mediæval abbeys, or in the market-places of modern but not too modern Italy, had no doubt been a useful function, judging by the remains of his performances, but who in modern London was a doer of nothing to speak of, or of nothing but what could be done quite as well without him. As a matter of business, we know this to be mere folly ; there is perhaps nothing in the work of this world which the untrained intelligence can never hope to accomplish, if the proper design of a high-class building be not such a thing ; and the continual endeavour of uninformed persons to do their own architecture, in spite of a thousand failures, is only evidence, indeed, of the fascination of the unattainable. Cole, however, seems never to have permitted himself, as so many do, to be an amateur architect, or even to have encouraged anyone else to be so ; what he underrated was, not art, nor even business, but men. His whole soul was wrapped up in detail, and he found the architects, as he thought, to be devoid of the knowledge of such detail, and content to trade upon a little experience merely in the drudgery of supervising building-contractors. When he fell in with an architect like Digby Wyatt, who knew all that he himself knew, or could wish to know, of the arts of detail, and who knew also that which he acknowledged to be beyond his own reach, the whole volume of the historical art of splendid building, he could honour him, and did honour him as far as was convenient ; but if the mere art of building, without the arts of detail, were alone in question, his opinion was that the Royal Engineers could manage that quite as well as anyone need desire ; and, indeed, all the better, because of one thing, that they were soldiers under discipline, and not like a good many architects he could name who were not under discipline, and whose successors, if we must tell the truth, are not under discipline yet.

The fact that the Prince Consort had built Osborne in 1848 without employing an architect (although the builder, of course, employed one) may have been encouraging to Mr. Cole when they came to compare notes ; but the view of the matter which I prefer to take, as I have already suggested, is that both of these extremely intelligent and earnest men were in fact exercising shrewd foresight, and not merely cherishing a personal crotchet. At any rate, the immediate result of the Great Exhibition of 1851 was to open the eyes of Englishmen to the fact that the subtle spirit of artistic design ought to run through a great many branches of industrial production, which they had been accustomed to regard as scarcely worth the trouble. That many of these were more or less related to building, or to the decoration or occupation of buildings, was plainly manifest ; and the triumph of Cole was that he had laid a foundation for the popularity of the whole world of decorative arts, and, amongst the rest, the minor arts architectural. The Exposition held in Paris in 1855 carried still further the same idea ; and some English architects began to perceive that their studies must go more and more into the detail of general art. Architecture was therefore now on the move in a new direction.

Under the remarkably clever personal administration of Cole, the practical outcome of the exhibitions speedily acquired form and substance in the institution of National Schools of Design, and eventually of the South Kensington Museum. The establishment of the Crystal Palace also at Sydenham, for an artistic popular resort, ought to be coupled with these undertakings, as being a measure carried out with the same end in view. As regards architects, it was no doubt a remarkable, and perhaps unfortunate, circumstance that a duke's gardener had to come in to design the Exhibition edifice, as if to show that it was not in artistic building alone that architects failed to keep pace with the times, but in scientific still more. We are not bound, however, to accept this view of the incident, and certainly Paxton never made his mark in either art or science.

"South Kensington," as it has long been popularly designated, in the character of a somewhat self-assertive bureau of the Government, may, I think, be described as the head-quarters of art multifarious, no longer academical, but essentially non-academical. By academical art I mean to indicate, in the restricted

sense, the old conventional "circle of the arts" as accepted by the Renaissance academies, comprising painting, sculpture, architecture, and no more, and all on the high level only of dignified tradition. When, for example, no longer ago than 1854, we find Mr. Tite's contribution to the Royal Academy Exhibition to have been "A Composition of the Works of Inigo Jones," and Professor Donaldson's "An Architect's Dream, or "Sketch of a Design for Opening the Crypt of St. Paul's" (after the manner of the Invalides at Paris), we can acknowledge now that academicalism had reigned quite long enough. We can also acknowledge now, when we have in a great measure enfranchised the practice of the art from such inconvenient formalism, so that our Classic and our Gothic alike are often almost too free in treatment, and too demonstratively defiant of the categorical criticism of the schools, that the practical function of the architect has acquired, at the same time, extended limits. He can no longer rest content with having provided a building that is merely conveniently planned, properly constructed, and well proportioned, which other hands shall then clothe with decorative work, and furnish with ornamental accessories; there is finishing work everywhere, minor art work, which is part and parcel of his scheme, and which he must himself design and control; there is characteristic carving, for instance, and he must direct the carver; painting, still more; there may be even set pictures and statuary sometimes; there is metal-work, glass-work, plaster-work or some equivalent, even paper-hanging or some equivalent, and so on; there is floor-work, wall-work, cabinet-work, furniture-work; sometimes upholstery, carpets, tapestry; a multitude of miscellaneous fixtures and fittings, and even unfixed ornaments; all of these may more or less put in a claim to be "endowed with artistic merit" by the one designer, lest anything unexpectedly awry should mar the effect of the whole design. And this great change in the scope of the architect's work has come about, I think, in response to a corresponding change in public feeling, which must be associated with the operation of South Kensington policy. Indeed, I am almost inclined to say that the *bric-à-brac* style, for such it is, of what we call Queen Anne architecture, is properly the South Kensington Museum style. Cole personally, the paramount genius of South Kensington, was originally, as Felix Summerley, content to devote himself for ever to *bric-à-brac.* There are cynical critics who will speak of the whole Museum as *bric-à-brac* still. And I, for one, have no objection to this, if I may take leave to identify with the name of *bric-à-brac* the idea of art multifarious and non-academical, that which underlies the entire range of the minor arts, unformulated often and unconventional, but constituting an inexhaustible source of everyday enjoyment which Academies, when inflated with the pride of empty traditions, are disposed to ignore rather than attempt to work.

But the Gothic revival, no doubt, is entitled to claim a considerable share in this expansion of the architect's work,—his work, let me say, as chief of all the workmen. Pugin, for instance, was especially an apostle of the minor arts. The Neo-Greek dilettantism that preceded his day, and the Georgian philistinism together, may be said to have shut the door upon them. It was under the successors of Pugin,—his direct successors in Gothic enthusiasm,—that they acquired the form and force they now possess in architectural business. South Kensington could never, perhaps, have converted the narrow connoisseurship of *bric-à-brac* into an expansive public interest in every possible kind of decorative and ornamental designership, but for the fanaticism, as it is called correctly enough, of Pugin and his school. And yet Coleism and Puginism were but unconscious allies, and are no better still. To this day South Kensington recognises little beyond Italian Renaissance, whereas even our Queen Anneists,—themselves stanch Mediævalists quite recently,—would rather have turned to anything else they could find. At any rate, the point I desire to make is this,—that the epoch of the first great international exhibitions is to be identified in the history of English architecture with the rise of the minor arts, which have thus been progressing amongst us for about thirty years.

The Gothic revival must now be described for its own sake. In the language of our popular Protestantism, this great movement was simply a return to the artistic style of the Roman Catholic or Mediævalist Church, of which it has been truly said that it is "the Church of Poetry and Art." At the date of the great exhibitions, Gothicism had got so far as to have acquired not only the undisputed possession of the whole ecclesiastical field in English architectural practice, but the disposition to claim whatever secular work was worth having. The theory that Italian art was only suited to Italian soil, that England required a style that was English, and that the only English style was the Gothic, was boldly advocated; and in 1857, when the Government instituted a public competition for the intended War and Foreign Offices at Whitehall, the competitors were found to be so equally divided in taste between Classicism and Gothicism that the adjudicators felt obliged to place the representatives of the two schools in alternate order for the prizes, to the number, I think, of fourteen in all, as an official acknowledgment of the absolutely equal value of secular Gothic and Classic in public esteem. We all know how in the end Scott's Gothic design was demonstratively

selected for execution just before Lord Derby's Administration quitted office, and the style, almost still more demonstratively changed to Classic when Lord Palmerston came in. Such was the Battle of the Styles.

The chief merit, perhaps, to which the Gothic party laid claim was the resuscitation of the Mediæval principle of truthful articulation, or the correct correspondence of the motive of superficial design with the motive of underlying construction. The styles of the Renaissance, they argued truly enough, were almost hopelessly entangled in shams, whilst the Mediæval, they said, had nothing to conceal or to disguise. This was a great step in the right direction, for false architecture cannot be true art. It is not to be affirmed, however, that our Gothic architects quite acted up to the pretensions of their school; it was scarcely to be expected that they should; the habit of fibbing on the drawing-board, persisted in from the time of St. Paul's Cathedral (which, with all its merits, is a mass of fibs), had become inveterate in England; and even now the Spartan principle that the facts of construction shall never be compromised in the design of superficiation is much too feebly recognised.

But the Gothic revival, as soon as it had acquired its full strength, brought about another result not so satisfactory to our professional repute. Architects were now divided into two "camps" (to use the appropriate language of Sir Gilbert Scott), regarding each other with "mutual scorn." English people may fully appreciate in politics the advantages derived from the antagonism of parties, but in art they do not. Consequently, when Gothicists proclaimed Classicists to be, in plain language, foolish brothers, and Classicists said very much the same of Gothicists, the character of the whole profession was lowered inevitably, and the effect was only too distinctly apparent in Parliament and the press. Within the profession itself the authorities were divided in doctrine thus:—Gothicism rested its claims of superiority chiefly upon its qualities of honesty and masculine fortitude, which, in the work of Street and some others, were soon developed into something like a contempt for the graces; whereas Classicism relied upon the concurrence of all modern Europe in its adoption, and, while fully acknowledging the sin of sham, deprecated the substitution of ugliness for beauty, however masculine the one might appear to be, or however feminine the other.

There thus arose outside the profession a new philistinism. Before many years it acquired unexpected importance by reason of the appointment, quite accidentally, of Mr. Ayrton to the office of First Commissioner of Works. Ayrton was a very Goliath of the Philistines, and when Edward Barry had the temerity to encounter him he went down before him in the most melancholy manner; and unfortunately he dragged us all with him, so that the unpopularity of architects became established as almost a national principle. But it is due to South Kensington to give it most of the credit, or discredit, of this consummation. Cole may be said to have hated not only architects, but all classes whatever of professional artists of the academical order. He regarded their pretensions on all hands alike as a mere traditional, conventional, and spurious self-importance, impeding the progress of those minor arts which he considered to afford the true pabulum for national taste. Accordingly, as a rule, whatever had to be done artistically under Cole must be done, so to speak, non-professionally; and, inasmuch as architecture was the most prominent of the professional arts, it was determined that, when building had to be done for South Kensington itself, the professional architect should be emphatically set aside. The military engineer was demonstratively substituted. Captain Fowke, a young officer of much general ability and of an amiable and well-disciplined nature, was made the representative of this policy. He became a favourite with the Prince Consort; he proved to be a man of large ideas; he entered thoroughly into the new system of artistic enterprise; he made a special study of new materials for design, such as iron and terra-cotta; and he was at once a judicious chief and a judicious subordinate. He died early; but if he had lived longer he could scarcely have accomplished more than he did. His successor, General Scott, carried on his work on the same lines; but Scott, being of a more genial temperament, allowed the architectural world, if not the public, to discover at last the hollowness of the system, by acknowledging frankly that he himself was no architect at all, even although that very grand edifice, the Albert Hall, was nominally his personal work. But I need not remind you that, when the Albert Memorial had to be built, South Kensington discreetly made no attempt to commit it even nominally to the artistic mercies of the Royal Engineers.

We have now arrived at a period of less than twenty years ago; and the condition of English architecture was this, as illustrated in the great competition for the Law Courts and the National Gallery. The Battle of the Styles was still in progress, and it cannot be denied that the Gothic party was victorious all along the line. Scott, Street and Burges were its most prominent champions. Scott had the unassailable leadership in ecclesiastical work everywhere. But the qualities which made him so popular socially with a body of men like the clergy rendered him incapable of maintaining that militant attitude which so much better suited the

disposition of his eminent pupil Street. Again and again, in obedience to the call of partisanship, and to the dictates no less of his own sincere earnestness in the admiration of what we may call the milder Gothic, Scott came forward as a combatant Mediævalist, and even made use at times of language that appeared to be strong. But no one was ever any the worse. In Street, however, the genius of the Revival possessed a soldier after its own heart. Even Ayrton had met his match; and, indeed, such has been the effect produced by the architect's undaunted attitude to the very end of his life, that the lawyers themselves in high places, exasperated at the universal anachronism and anomaly amidst which they are compelled, through sheer force of this one dead man's will, to perform their uneasy business, exclaim against him with bated breath. The third of our great Gothic trio, Burges, was not so much a man of power as of a certain playful fanaticism, which induced affectionate forbearance, and never provoked to wrath. With his intimates he was "Billy"; I wonder if any one ever called Street "Georgie?" But of the three, Burges was by far the most simple artistic spirit. Scott was a laborious and pushing man of business, with a congenial occupation; Street, a fighting ecclesiastic; Burges, an enamoured boy: one Low Church, one High Church, one No Church. But these three together represented the triumph of the great Gothic revival; and how strange it must appear to some of us that this triumph, which, like all our little mortal victories, seemed at the time so enduring, is now only an incident of history, and yet but a few years old!

By an ingenious contrivance of somebody's, the urgent demand for new Courts of Justice and the supposed desire for a new National Gallery were so combined together, and made the occasion of the brace of competitions alluded to, that Gothic should have its own way with one and Classic with the other. The Classic leaders of the day, however, were neither many nor strong; all the real artistic vigour was now Gothic—romantic. The result of the contest, after the customary vicissitudes, was the appointment of Street to build the Courts of Justice in an academic style, probably the most severely uncompromising that had ever been attempted in the world of archæological art. The edifice has but recently been finished. It is a monument of artistic resolution, and, of course of artistic skill. But it is much more than this. Such is the fearless muscularity of its artistic attitude, such the vehemence of its characteristic Gothic force,—let me at once say ruthless violence,—that without it the whole process of the Revival had been quite incomplete. But, for that very reason, the consummation at length accomplished, it was fit that the great movement should confess itself exhausted. Street died at the very goal, and his cause died with him. Except in ecclesiastical work, our modern Gothic of any high pretension is now no more; it has done its service, and done it well.

A popular successor to the style of secular Gothic has necessarily been growing up of late years by the mere action of natural law; indeed, such is the leisurely pace of architectural reform, that the new mode has been making its way slowly for more years than may be generally supposed. This is what is somewhat inexpressively and arbitrarily called by the name of the Queen Anne style, as if it were an act of mere revival. But I have suggested to you that it is really a *bric-à-brac* style peculiar to our own day, a minor art style which the influence of South Kensington may claim to have brought about, even if unconsciously. Within its own limits, and directly, no bureaucratic influence can do much in the way of producing a change of public architectural practice; it is a public demand which alone can have that effect. But it was South Kensington, as it seems to me, that created the public demand, now being satisfied by means of an infinitude of charming picturesque detail, chiefly appearing, however, in the design of small works. This is a much more philosophical way of accounting for the change than by attributing it to accident, or to any sort of personal authority. But Mr. Norman Shaw, whose modest and painstaking perseverance of character especially qualifies him, with the help of extraordinary dexterity of draughtsmanship, to be the unambitious agent of an artistic manifestation of this kind, fully deserves the credit of leadership; and he has been followed by a few equally brilliant men who have now unquestionably attained the status of a school, and one whose merits are becoming very considerable.

It is an exceedingly interesting exercise in criticism to inquire what is to be the outcome of this very peculiar movement. That it must gradually lose itself in a return to the universal European Renaissance, may probably be safely asserted. We must bear in mind,—neo-Mediævalist criticism being here altogether unscientific,—that this great historical style, taken in its entirety, although often called Italian as an alternative title, was never such a thing as a merely local Italian, which by accident happened to spread over Europe. It was a Modern European style, which took its rise on the spot where modern Europe had its birth, and at the date when modern Europe was so born. To say that it spread westward until it had overrun the whole European world as a universally accepted mode of building, and that it has been maintained in use ever since,

and still is maintained for all ordinary purposes without a question being raised,—except by people who are before the age, or behind it,—is to describe exactly the process by which every great style of design necessarily conquers its allotted territory; and when we in England claim credit with the world, as we do, and are fully entitled to do, for the exceptional merit of having originated and carried to great perfection the Gothic Revival, as a special act of characteristic motive which has now reached a turning-point after having fully satisfied our desires, what is this but a confirmation of the principle by a most unique exception?

If we now proceed to look a little more closely into the future, we have to account for three styles at present in use in England. First, there is the customary style of Modern Europe; secondly, the Revived Gothic, or the style of Mediæval Europe; and, thirdly, a certain popular and local mode which I say differs from both, but takes after both, essentially a minor-art style, and obviously transitional, prompting us already to ask ourselves what is, fourthly, to follow for a permanency?

In the first place, let us take the Gothic. Now the Gothic Revival,—which, as I have already said, was a return to the whole artistic system of the grand Mediæval Church,—*par excellence* the church of the imagination,—so far as its ecclesiastical purpose extended, has not by any means exhausted itself. Architects of the type of Mr. Butterfield on the one hand, and of Mr. Pearson on the other, have, I think, a long career before them still; that is to say, Gothic churches show no sign of losing their popularity in England yet. But in municipal and domestic work the case is different, and the secular Gothic, having culminated in the London Law Courts, has surrendered its claims for ever. But let me put the case in another way. The movement of national sentiment which produced the Gothic Revival, and in its particular form, I observe once more, it was peculiar to England, other nations being mere imitators,—was partly ecclesiastical and partly social. It was the social phase of it which operated in 1834 in the demand that the new Houses of Parliament should be designed in what was called "Gothic or Elizabethan." This was for the sake of archæology. Up to that date, and long after, when new churches were built in so-called Gothic, this also was not for any reason properly ecclesiastical, but on archæological ground alone. The ecclesiastical motive, however, was all this time developing itself, chiefly in the universities; and in due course it came before the general public in the rise and progress of a powerful theological party. Now we are not theologians here, but artists; and the way in which we have to look at this very remarkable social phenomenon is, I think, to regard it as inevitable artistic reform, using the term in a very wide sense. It was the introduction of the infinite artistic element, or poetic element, into the English Church, as opposed to a dull and dismal philistinism which had been in possession of it for many generations. We were to have for the future artistic music, artistic decoration, artistic ceremonial, artistic architecture, and, as I venture to add, artistic doctrine and discipline. This, I may safely affirm, is the harmless way in which the people at large have always looked at the case; and it is especially proved to be so by the circumstance that even the Nonconformists and the Scotch Presbyterians have accepted the new system as far as they could. I need not remind you how earnestly it was embraced by English architects; in fact, we may say that architecture has been almost the helm of the enterprize, answering to every call with a readiness of resource for which English genius may justly claim the lasting admiration of the artistic world. It is the ecclesiastical Gothic, therefore, as the style of artistic religion, that I regard to be the only natural or historical form of the Revival. That it has taken a strong hold upon the affections of the people cannot be doubted, and I scarcely care to ask you to fix a period for the duration of its popularity. Like all other manifestations of sentiment, it must in time give way to something new; but let us hope at least that it may be something better rather than worse. Looking again at the influence of the minor arts, it must be borne in mind that, as they stand in practice, they owe almost all their present importance in England to their revivification by means of ecclesiastical architecture; so that, if it should be through the minor arts that the coming style of architecture is to be determined, there seems to be no reason why this should affect our revived ecclesiastical Gothic otherwise than by the continued amelioration of its sometimes too masculine manners, an effect which is not by any means to be discouraged.

As regards, in the next place, the exact position amongst us of the general Modern European mode, from which the French, the Italians, and even the Germans have never swerved, as we have done,—except in mere superficial imitation of ourselves,—I have only to repeat what I have already said, that we cannot help returning to it, and that, indeed, we are already so doing.

Turning now to our third manifestation,—the so-called "Queen Anne,"—I think one motive which lies at the root of it may be thus described. Secular Gothic had for its principal basis the element of picturesqueness; it was, indeed, frequently designated the picturesque style, as thus distinguished in spirit from the Classic style

or style of repose. When, therefore, it was found that municipal buildings and private dwelling-houses designed in this manner, unless all authenticity were expressly sacrificed, proved to be unacceptable to the ordinary feeling of the day, and that, in fact, English common sense, while admiring the picturesque greatly, pronounced against the practical inconvenience of obsolete forms and arrangements, it was necessary to find something to take the place for a time of the rejected style, without surrendering the picturesque character. Mr. Norman Shaw and his colleagues have accomplished this end, as I think, successfully; and it was done by means of the subsidiary art of what I will venture to call *sketchmanship*. The Gothicists had become enthusiastic sketchers; Street was the very prince of sketch-making out of doors; in fact, architectural sketching of the picturesque order was found to be the *forte* of Englishmen, bringing out in all its force the rough-and-ready national preference for experimental study instead of philosophical. So what was done was to make sketches of a new class of picturesque old buildings, not necessarily pure Gothic, or not even Gothic at all. I am afraid I must say that the specimens selected turned out generally to be Dutch. In a word, with the help of the good-natured name of Queen Anne, whose reign coincided sufficiently well with the use of a kind of Dutch art in England, there was at length brought about a certain popularity for red-brick buildings, with features neither Gothic nor Classic, but quaintly pleasing, and, so to speak, of a sort of old English type. Nothing could be better suited for such an occasion. The recent development of the minor arts, moreover, was fully recognized; for Dutch art and *bric-à-brac* are never far apart. And so the Queen Anne architects are making very good innings, and just now are doing better and better work daily, although, no doubt, still leaving room for improvement. Some of the drawings of interiors more particularly, which are produced under names unknown to most of us, seem to me to evidence a degree of manual dexterity which ought to tell upon the artistic handling of a higher class of architectural style when the time comes.

What, then, is the higher style to be? I can only suppose, as I have said, that it must be the standard Renaissance in some form or other. We may now ask, therefore, whether England is to insist upon producing any modification of it to suit her own national character; and here a very interesting point comes into view. It is said that, in the history of modern intellectual development, the two races which occupy Europe, the Latin and the Teutonic, stand in this relation to each other, that the Latins initiate what the Teutons perfect. The more imaginative genius of the French and the Italians, that is to say, having its function in the origination of almost all great discoveries, it is the more practical scientific power of the Germans and English that assumes the task of their development. If this be true with reference to the arts, England in the coming generation may be destined to take the lead of even France; and I for one have no objection to look this possibility fairly in the face. Already the Ecclesiastical Gothic of England in our own day may certainly hold up its head beside anything that France has done; and, perhaps, in the coming Renaissance we may find ourselves no less able to compete with our gifted neighbours. Bright and joyous as the French Renaissance always is, there may be a certain vigour of manliness reserved for the English, which, in an age of increasing manliness and increasing English influence, shall accomplish unexpected results. It is of little use to speculate about the mere details of one academical style or another, and the introduction of this class of features, and the rejection of that, as if personal authority were to govern the course of events; natural law will have its way in this as in all else, and if English intellectual enterprize is to be fairly challenged to accomplish an adaptation of the somewhat hard-worked forms of the Italian-European, I do not see why in the next century an English-European style should not take the lead throughout the world.

Let us further inquire what is the present drift of English architectural sentiment in the abstract. The Mediæval romanticism which a few years ago was the dominant feeling has recently been disappearing with such a strange rapidity that it seems almost doubtful whether the secular Gothic party have not deserted to the enemy in a body. Now, I confess I should be sorry if this were really so; because I think the peculiar artistic enthusiasm which actuated Pugin, Scott, Street and Burges, cannot well be dispensed with for some time to come. No doubt a new enthusiasm will spring up; but the Queen Anne movement is not such a thing; it is an impulse of a much more feeble and evanescent character. The attitude which is assumed by the somewhat mysterious organization of "The Society for the Protection of Ancient Buildings" seems for a moment now and then to be all that is left of the Gothic enthusiasm; but on closer acquaintance this impression is not confirmed. For it declines emphatically to be considered representative of Gothic alone, or, indeed, we may say, of Gothic at all. Its object is not even artistic, but historical; to preserve what is left of the past in the most indiscriminate way; whether good or bad, old or new, preserve it all, so that the reverie of the wayfarer may have not only something authentic, but everything veritable to dwell upon, even when the light of life, perhaps never a very bright light, has quite gone out. This, I need scarcely repeat, is not an

enthusiasm of art,—indeed, scarcely one of archæology; and it has become identified with architecture only because buildings are the most conspicuous relics for such a form of patriotic reverence. I may add, moreover, that the influence of archæology itself upon architecture seems within the last few years to have given way; and I think this is to be regretted too, inasmuch as our archæologists, like our old antiquarians the *dilettanti*, if only as matter of prestige, brought the element of learning into prominent connexion with our noble work. The minor-art architecture of to-day exhibits again in these respects its conformity with the South Kensington principle, which, in making art a thing of popular skill, and not of academical knowledge, widens the ground that is cultivated, but at the expense necessarily of the depth of cultivation. That our present age is one of superficiality in many other matters besides this, is a well-established fact; and I am not sure that it is to be regretted; for if we can see that the field of art, as actually enjoyable by the multitude of us, is thus being extended so largely, we may well be content to let the learning reappear in its own way and at its own time.

But there is another point to be noticed here, namely the way in which the architectural arts are being controlled and even directed by the artifices of draughtsmanship, or sketchmanship, regarded as a delightful, but delusive, sleight of hand. In the minor arts of decoration, such as glass-painting, carving, painted ornament, and so on, it is easy to see that clever drawing is in a great measure the essence of the artistic manifestation; but we cannot shut our eyes to the fact that in the now very pleasant work of furniture design, when in the hands of architects, the same clever drawing is fully accepted in the same way; and, as matters go, it is but a step in the style of the moment from furniture to building. Our architecture has thus come to be sketch-designed and sketchy, careless and vague in detail; a thing of scene-painting, picturesque at any price, restless and not necessarily anything else; exceedingly clever on paper, and, when carefully carried out, pretty and piquant in execution, but greatly wanting in the nobler qualities. I do not suppose, however, that this will last long; and, even before the so-called Queen Anne mode itself gives way, we may expect, I hope, to see a more careful manipulation of the modelling becoming universal: indeed, it is already making progress.

Another matter of sentiment to be noted is the abatement of that cynical poeticism which was introduced by Mr. Ruskin. I never could understand why this exquisite dream-painter should have ever taken up such a subject as architecture, except for the indomitable courage of the thing; but there can be no doubt that his visionary doctrines,—and the more visionary necessarily the more vague,—have had a great effect in helping what was weak English art to conquer strong English philistinism; and, if this involved a certain amount of inconvenient romancing when applied to the practical work of architects, such a result might be expected to appear, and the effect of the medicine must be allowed to wear off by degrees. At all events, now that the artistic spirit has taken possession of us, we need not grudge our thanks to the influence, perhaps upon the public mind more than the professional, of the writings of Ruskin.

But we have, nevertheless, still to face the fact that in high places in England a new philistinism has been for many years acquiring a certain force,—indeed for thirty years,—an influence antagonistic both to architecture and to architects. The building of the Houses of Parliament in a Gothic style was no sooner fairly under way than the common sense of the more utilitarian order of men connected with the Legislature revolted against it as an anachronism. The architect of the structure, even if he himself had been at first of the same opinion, had, of course, to take all the blame; and when the edifice came at length to be occupied, there was a cry raised of inconvenience and incongruousness, which has been kept up ever since. In course of time, when the son of the great architect, thinking he had acquired by his father's bequest the position of an hereditary successor, came into collision with Mr. Ayrton, and was ruthlessly defeated by that champion of the Philistines, backed by the unsympathetic logic of the Courts of Law, it would be idle to affect not to see that the pretensions of architects,—the Prime Minister himself had to say they were untenable,—had come to be seriously mistrusted. The immediate effect of it was that the Government determined to dispense with outside architects by making use of the officials of the Department of Public Works; and it is still understood that this rule is practically in force for a permanency. The charges made against the profession on this ground are shortly these,—that convenience and economy are sacrificed to monumental appearance, and that the severe character of the commercial contract with a builder is tampered with by the introduction of extras. Upon these questions I need only observe that the most successful architects in England from time immemorial,—I do not say the most artistic,—will be found to have been the most mercantile in their manners; and secondly, that the artistic element in architecture is not recognized by law, or recognizable in any way by the legal mind. I may also point out that the typical English gentleman,—and typical English legislator,—is a person whose ideas of building are still of primitive simplicity, and that his impression of an architect's business is equally devoid of sentimental considerations. But I do not consider that the so-called unpopularity of

architects goes really deeper than this; and if any architect who happens to obtain Government employment, —scarcely ever a desirable thing by the way,—will condescend to bring his ambition down to the practical level of his private business, and to do everything in strictly commercial form, there is no reason why he should not give satisfaction.

One word more must be said here upon the influence of competitions. Looking at the eagerness with which these contests are entered upon, the disregard of commercial calculation that is manifested even by the leaders of the profession, and the unseemly bickering that invariably results, how is it to be expected that such men as are at the head of public affairs in a commonwealth of commercial common sense like ours should regard either architecture or architects with due respect? The logical conclusion obviously is that the designs which are so freely offered for nothing must be worth nothing, and that the men who are so ready to work for nothing must be taken at their own valuation. Nevertheless, although I believe it is almost invariably the case that it is not the proprietors that call for a competition for their own sake, but the architects who virtually solicit permission to compete against each other, I am afraid, in speculating upon the future of the profession, we must expect this practice of competing to increase rather than diminish. Sooner or later, however, some check must be put upon it, either by the good sense of the public, or by a feeling of shame on the part of the architects themselves; up to the present moment I do not see that any effective steps whatever have been taken towards that end. Still, on the other hand, I cannot but frankly acknowledge the opinion that, without the peculiar artistic exercise and enterprise which competitions induce, English architecture could not possibly have done all it has done during the last half-century. I chiefly object to the great waste the practice occasions, not only in money, but in time, temper and character.

I may now say a few words,—still keeping to the artistic view of my subject,—upon the position of architects in respect of business. I need not repeat in any way what I have said of the advancing popularity of minor-art architecture, and the increasing competency of our architects to deal with it. But what of the still more rapidly increasing numbers of the men who have to live by it? And what is the state of their organization?

In the first place, I may express my opinion that the Institute of Architects, established now fifty years ago under circumstances very different from those of the present day, does not display either the vigour or the intelligence which the service of the profession requires, whether we look to the interests of the art or to those of the artists. It is to be hoped that something may be done in that quarter before long; but it must take time: thirty years hence, at any rate, the Institute, we may safely say, ought to be much more earnestly devoted to the practical utilities of art than it is now.

The Royal Academy, also, if architectural art is to retain its connexion with it much longer, must, I venture to suppose, enlarge its views of the minor arts considerably; and here I think we may fortunately expect to see both painters and sculptors entering into the matter with understanding as well as with sincerity.

Turning next to the educational question, we find that examination tests are becoming the order of the day; but whether, in respect of architecture, the introduction of artistic design into the programme can be accomplished, seems still to be matter of doubt. That some kind of academical diploma for art-architectural in its expanding form must, however, sooner or later, be contrived, both to conciliate the artist and to meet a public demand, can scarcely be matter of doubt.

A circumstance that must not be overlooked is the still-increasing employment of professional architects all over the country, which, looking at the sum total, is so far encouraging, even if individual instances of dissatisfaction are numerous. Not many years ago there were but few architects of really good position, except in London and the larger provincial towns. Now the smaller towns, and some that are almost villages, are occupied by practitioners who are frequently quite equal to their metropolitan brethren in skill. The pupils also of provincial men have in some instances better work passing through their hands than those who are in average London offices; and, thanks to a study of the photo-lithographic illustrations of the professional journals, their draughtsmanship is often of quite as high an order as the best in London. All this points to a condition of things in the near future throughout England in which men architecturally educated are to do a vast amount of good art-work in one way or another, and, therefore, in many ways. Consequently, when I hear the question asked, as I often do, what is to become of the increasing host of young architectural pupils, my answer is that they will be drafted off more and more before long into the service of many charming arts. For there is a certain peculiar characteristic in architectural training, namely, the habitude of constructional design, which, even while as yet not so devoid of the old make-believe as we could wish, is still expressly

calculated to prepare the mind for that association of the superficial with the substantial which becomes the most essential charm in all formative and ornamental art when once publicly understood, and which the mere counting-house designer acquires, if at all, under great disadvantages.

Another point of importance in our prospect of the next generation of architects is the work connected with so-called engineering construction. Perhaps the most regrettable weakness of English architects at the present time, in point of dignity, is their want of that higher scientific skill which they allow engineers to monopolise. To give a familiar instance, it is quite common for an architect of eminence, when he happens to have ironwork of any magnitude to deal with, to hand it over altogether to an engineer to design, like a solicitor employing counsel to draft a deed. Now this is to be regretted. The reason for the practice obviously is that there is no sufficient current of such work passing through the architect's own hands to keep him up to it, and that he, therefore, must call in a specialist who does nothing else. It would be useless and, indeed, unfair to reject such an argument; but what I want you to do is, to consider what a far superior position the architectural profession would occupy if it were publicly understood that they did all such work for themselves, even if the fact went no further than this,—that the aid came from a specialist architect and not from an engineer. Still, looking at art, what I should like to see is an architecturally-educated man designing such a thing as the most advanced ironwork, and introducing true architectural art into it as his design went on. Otherwise, if one of these two kindred professions has to call in the specialist aid of the other, why should it not be the engineering constructor who calls in the architectural designer? Why should all our building operations of the so-called, and improperly so-called, engineering order,—viaducts, bridges, great roofs, railway stations, piers, embankments and much more,—be left barren and unfruitful of grace because the designers of them, professing nothing of the artistic spirit themselves, assume that it has no connexion with their work? Here, I would fain hope we may see another sphere of business, and, indeed, one of vast importance and grandeur, opening out in the next generation to the English architect.

To conclude, in answering for yourselves the question what is to be the position of English architecture, let us say, thirty years hence, I invite you simply to regard the profession as one that has been advancing during a corresponding period of the immediate past in a certain direction and at a certain pace, which a retrospect of recent history such as I have offered seems to indicate clearly enough, and then to follow forward the same line at an increasing rate of evolution. If the next thirty years should do as much as the last fifty have done, then it becomes easy to understand that the process of development would have to cover as much ground as has been covered since the time of the foundation of our Institute, and the inception of the design of the new Houses of Parliament, in the old-fashioned reign of King William IV. We do not require to imagine the occurrence of any catastrophe; but the change produced upon the face of our art and our profession must undoubtedly be great, and, perhaps may be greater than any argument such as mine suggests. For, during the last fifty years, Dilettantism has gone down before the Romanticism of the Gothic Revival; and this in its turn has at length given place, after adding a very glorious chapter to the history of the art. The old philistinism of the Georges has been vanquished by the South Kensington movement, as a movement of the people; and a new philistinism has arisen, which has to be vanquished, and will be, in due time. The empty conventional formulas of the academical arts have been vigorously assailed by the new non-academical substantial facts, and the minor arts are already so far triumphant before the common sense of England that architecture itself has taken service in their cause, and a great deal for the better if a little for the worse. In these campaigns the whole lives of such great men as Pugin and Barry, Scott and Street, have been expended, and the task of great writers like Ruskin and Fergusson exhausted. Cole has passed through his long and busy, masterly and masterful career. The genial influence of Prince Albert, infinitely beneficial to the artistic sentiment, has already survived his own august life for three-and-twenty years. This artistic sentiment has for the first time spread all over our country, one of the kindliest graces of the splendid Victorian age; and England is now ready to enter upon a new chapter of her magnificent history, not, let us hope, with arms in her hands, whether for conquest or defence, but with the fruits of science and the flowers of art. And possibly,—indeed, I venture to think not improbably,—it may be the destiny of England at a period by no means remote, in the development of the advancing scheme of Anglo-Saxon civilisation, to assume a leadership, —such as she already possesses in so much besides,—in the illustrious art which it is the pride and the joy of this assembly to represent.

ROBERT KERR.

[Remarks by the Rt. Hon. A. J. B. Beresford Hope, M.P., *Past President.*]

I have certainly passed a very interesting time since my good friend Professor Kerr began his Paper. I had anticipated a prophecy, but instead of a prophecy I have had a retrospect. Now I think Professor Kerr showed great wisdom in that. There is a good saying,—I believe it is an American one,—that Sir William Harcourt brought up the other day in the House of Commons, when he was run into a corner. He said he never prophesied unless he knew. Now, Professor Kerr has said a great many things very cleverly and very epigrammatically. With a good many of them I agree very much; with others I do not agree so much. But to traverse his Paper from first to last would be an impossibility, with any due Christian charity to the nerves and spirits or the somnolency of the gentlemen I have to address. So I will let many things pass. I will even admit what was the hardest to swallow of all, the words the Professor uttered in praise of that adventurer, the Third Napoleon. I think that Professor Kerr began with much too magnificent a philosophy. He had to leave his philosophy as he went on. He began with a very magnificent picture of art as a course of successive evolutions,—successive developments and improvements; and the whole result of his Paper is that, instead of development or improvement, it is a constant going forwards, then going backwards, and then going round, and then going to the left and then going to the right, and such I believe it really is. I think all of us as we grow older—while I hope we may never become blunted in our principles—get more moderate in our hopes and expectations; that when we have a success, thankful as we may be for that success, learn to regard it as a warning that the march of victory is conditional, and that only by unremitting exertions can we rise from height to height. Equally we learn that when we have a rebuff, even though that rebuff may be the transitory breath of a change of the wind, we may hope that it will be the prelude to some unexpected success afterwards; or, may be, a salutary training in some particulars, in which we are too exuberant, too self-confident, too intolerant. I made notes of several points as Professor Kerr went on. No one will expect that I should disagree with him,—indeed, I thoroughly agreed with him,—in the picture that he drew of the dreary and prosaic period which elapsed between the epoch of that great man Wren and the revival of art in our age. By this proclamation he (the professor) has separated himself from that school which was a few years ago the accepted orthodox Classical school in the Institute of Architects and elsewhere. Still, I must point out that even in that period there were attempts, there were anticipations, there were scintillations of development, which, although they came to nothing, showed a divine originality which was born in the architect's soul. There is one man I will always quote as not having been duly appreciated,—a great man,—Nicholas Hawksmoor. I believe that in the work of Nicholas Hawksmoor there is much which forecasts types that have been more completely developed in our day, but which were overlaid by the pedantries of the time in which his lot was cast. Then Professor Kerr went on to speak of "action and re-action." There I thoroughly agree with him,—there was action and re-action,—but I think that "re-action" was hardly consistent with the idea of perpetual progression. However the point I would draw Professor Kerr's attention to is that his Paper has been mainly dealing with a period of from twenty or thirty years, and in dealing with a period of only twenty or thirty years great chronological accuracy is desirable. Now in yielding to the temptation to make some of his striking parallelisms, Professor Kerr has rather forgotten that caution. He quoted together Pugin and Ruskin, Pugin and South Kensington, Pugin and the Exhibition of 1851. I would point out that although Pugin had a court in the Exhibition of 1851, it was but the "song of the dying swan." Pugin died the year after,—1852,—and I think that the progressiveness of the different schools ought to have been differently stated. I say so with some personal feeling, having early in life been associated with men who may have been, like the conies, a feeble folk, but still they were men who in their feebleness and wilfulness tried to hold up the standard of truthfulness, and did hold up the standard of applied art,—I mean the ecclesiological school. This took place in the 'forties. I will say now,—and I think we have reached the time when indulgence in mock modesty would be to wrong the dead and to wrong the living,—that the torch was then lighted of architectural truth and of applied art which the Paper assigned to the 'fifties and to South Kensington. I do not think the ecclesiological party were unpopular, but they had not the *chic* to gain general popularity. It was a movement of a few people much spoken against. South Kensington, on the other hand, had all the *éclat* of the exhibition of 1851, with Royal patronage, with the magnificent,—what shall I say?—advertising genius of my friend Henry Cole,—for I will call him my friend. Cole has gone to his rest, and after all, notwithstanding our many quarrels, I am bound to say there was something genial and hearty about the old fellow. The ecclesiological movement began much earlier, and there were men connected with it who are too much forgotten now. There was one who died early in life, having suffered much from ill-health. In Richard Carpenter there was great genius which the world did not fully appreciate. I think Professor Kerr,

if he ever resolves his Paper into a book, which I consider he is bound to do, will have to go further,—he will have to illustrate it, to develop epigrams into paragraphs, and paragraphs into chapters. And if he studies a little more, if he will not make those aphorisms and parallelisms and those rough-and-ready chronologisms, he will find that Pugin was a man of an earlier date than he has assigned to him, and that the ecclesiological movement occupied a distinct position which he has not fully done justice to. Also Mr. Ruskin will be found to belong to a later date than Professor Kerr assigns to him, for while he has had great influence with many people, it can be conclusively proved that much of the Gothic enthusiasm of the day was previous to his *début*, although he was adopted and accepted with open arms as a great ally,—as a Gordon who had come to rescue the garrisons which were already in arms under the Gothic standard. So, too, about the South Kensington Museum. I think, with great respect, Professor Kerr has, for reasons which will be easily deduced from the facts he has given, a little exaggerated the influence of Mr. Cole, who was not the great leader of men he has stated, but a very clever *entrepreneur* who availed himself of the men who had already started on their career. Let them take Mr. Crace, for instance. Mr. Crace will nowadays be quoted as the model of a South Kensington man; but was he not a creation of Mr. Pugin? After all, Mr. Cole's work is a brilliant work; but it is not an enduring work. As to the influence of archæology on art I am a little puzzled by Professor Kerr's saying that the influence of archæology on art is fading. I should have thought the contrary. Now, what was the archæology of fifty or sixty or a hundred years ago? Nowadays it may be queer archæology, it may be misguided, it may be effeminate, it may even be sentimental, but surely the relation of archæology to art during the last fifty years years is not decaying, but, if anything, it is running to seed in a wild exuberance. Gothic is condemned, I see, for municipal buildings, but that I do not admit, although there may be something in what Professor Kerr said very cleverly of sketch-making having beguiled mayors, aldermen and common councilmen, into breaking out into "Queen Anne." After all, I give mayors, aldermen and common councilmen credit for good sense, and I do not see at all why, in ten or twelve years hence, a building of Burgundian Gothic should not be adopted for some town-hall in lieu of such most prodigious and gorgeous "Queen Anne" as that which was embraced in all its arms by the municipality of Leicester, a few years ago. Professor Kerr seemed to find some amusement in referring to its Dutch affinities, but, after all, the art of Holland was by no means a contemptible art; it has made a great mark in Europe. Gothic, I hear, has done its work; that, again, is an opinion, theologians would hardly say a "pious opinion," which facts refuse to justify. Then, going back to the chronology, which I venture to question, I find that Professor Kerr has put Pugin, Ruskin and Fergusson into a triplet together. Now Mr. Fergusson's leadership is later than the date assigned to it by Professor Kerr. Mr. Fergusson was first known by his book on the Topography of Jerusalem. That was a topographical discussion which had nothing to do with the general science of architecture, but his *History of Architecture* appeared in the fifties, after Pugin had come and gone and was dead, and after the Exhibition of 1851 had come and gone and was dead. Fully admitting Mr. Fergusson's power and the great work he has done, I must claim that he should be placed rather in the second than in the first row of those who created the architectural revolution of our times. It is said that with the Law Courts Gothic architecture has surrendered its claims for ever. That is a magnificent sentence, but if I were to say that with the advent of the Gothic revival Modern Classical surrendered its claims for ever, it would be equally true. The sentence is infinitely too magnificent and too epigrammatical to be capable of truth. I do not go in "for ever," I only go in for, say, twenty years,—and I ask any one here, supposing Professor Kerr and myself happen to be alive twenty years' hence, to call me to account as to which was most right over that question. Now I come to another thing I was rather sorry to hear, for it does not seem to be just, nor does it seem to be logical. It is this, that Mr. Burges was deficient in power because Mr. Burges was called "Billy." No doubt Mr. Burges was christened William, and undoubtedly, if he had been christened Richard, that might have led to his being called "Dick,"—but whether he were Billy or whether he were Dick, I am very much surprised,—talking seriously,—that any one of Professor Kerr's ability and knowledge, who knew his contemporaries' work so intimately, should predicate want of power in that great genius, for he was a genius, in the face of the evidence of the truth and great power which his works displayed. I always feel it a moral and artistic duty to stand up for Burges. With his great good nature, with his *bonhommie*, and his extraordinary fun and wit, he very often did not do justice to himself: he was too real and natural a man to pose for posterity. Therefore posterity, beginning with those who knew and survived him, should stand up for him and proclaim that he was really a great genius and a conspicuous power. I remember that when Burges was appointed one of the architects to compete for the Law Courts I went to him, and said, "Well, now, Burges, you have got this chance; I

"know what sort of fellow you are; you must not spoil your chance by any of your jokes." Well, he told me that he would not, and after he had sent in his designs he came and said, "I have been good, indeed; the "only joke I made was to stick the recording angel over the Record Tower," and I said, "All right, that will "not do you any harm." Another anecdote is honourable to both of the men concerned. When the exhibition of these drawings took place, in that shed in Lincoln's Inn, each architect had a separate cell, round which his drawings were hung. As I was looking at Burges's drawings one day a friend came in, and, tapping the drawings, said, "I would not mind being beaten by those!" The man who said that he would not mind being beaten by Burges's drawings was Street. Those drawings were a noble set, and it was a great credit to Street to have the Law Courts assigned to him with such a magnificent series of drawings as Burges's in competition. Well, to go back to the Paper. Professor Kerr grew poetical, and he called Street "High Church," Scott "Low Church," and Burges "No Church." There are six syllables for three men, and they make up a most incomplete and inaccurate description. It is an epigram intended in good humour, I am sure, but it would be a great pity if it were accepted as historical portraiture. It is, perhaps, intended as historical portraiture of the Du Maurier School; but it is not that of Livy or Tacitus. I have made more notes, but do not think they are important enough to refer to. The whole Paper is a very brilliant one; it is a good-humoured paper; and above all it is,—after all that Professor Kerr has said of the future of ecclesiastical Gothic,—a recantation, not at all complete, but still a recantation quite sufficient for him, and very refreshing, of the old doctrine of the Donaldson, Cockerell and Basevi school.

A. J. B. BERESFORD HOPE.

XIX. THE PUGIN TRAVELLING STUDENTSHIP: EXTRACTS FROM AN ACCOUNT OF PRINCIPAL FEATURES OF BUILDINGS SEEN IN OXFORDSHIRE. By Mr. WILLIAM A. PITE, *Pugin Travelling Student.*

[Addressed to the Council of the Royal Institute of British Architects, June 1884.]

THE ecclesiology of Oxfordshire has many claims to the student architect, and perhaps there are but few counties which present such a proportion of good work both in the large and the small churches. There are several exceedingly fine spires in the county. Perhaps the most important one is that of St. Mary-Witney [Illustns. xlv, xlvi.], the tower of which is placed at the crossing of the church, but not in the centre of the transept; the tower being placed east. The roofs, with the exception of the chancel, which was restored by the late Mr. Street, R.A., are flat; the thirteenth-century dripstone courses are discernible to a high pitch. The tower commences from the ground, with four lancet arches opening into the church, finished at springing with a simple abacus; above this is the present ringing-chamber. This has a triforium passage running round (see St. John, Burford; also section in Illustn. xlv.). This passage is reached from a well-contrived staircase—circular stairs but square case—which also tapers up to the tower. This staircase is at the south-east angle of tower, and formerly gave access to the ancient rood loft, the landing of which is still discernable; the staircase eventually blends itself into the buttress upon the eastern face of the tower. The whole is a work of the thirteenth century. The triforium arches are ∧ shape, moulded in two orders; the passage is slightly inclined, and gives access to a point at the north-west angle, where the stairs were kept within the compass of the wall space. The belfry openings are three moulded Early English lancets on either side with labels. Those upon the western face are shorter, the weathered cornice below being also raised thus showing that the ancient high-pitch nave-roof was considerably steeper than that which covered the chancel. The tower is finished by a corbelled cornice, weathered twice above before the spire is reached; the pinnacles are octagonal, with beads at angles, and are decorated with nail-heads and trefoils, the spires being finished with heavy finials. But what attracts universal attention are the spire-lights, which are of exquisite design; they are in two panels, with a dividing transom in the centre, with trefoil heads and a plate tracery, quatrefoil in the gable, on the apex of which is some double plated cresting of bold composition. The spire is broken mid-way with some small openings and a band having sculptured bosses where it meets the roll of spire. The spire is finished in a foliated finial and weather vane. Internally the church is of vast extent, and it seems difficult to account for so large an edifice in so small a town. The nave arcade has no capitals or even abaci, and the arches are simple splays;* the nave has five bays, the central one being higher and wider than those upon either side. This is difficult to account for, as no external evidence seems to be forthcoming. Witney has western aisles to the transept; on the south side is a remarkable window of fourteenth-century date (see elevation in Illustn. xlvi.). There is a fine north porch of various dates, from twelfth century to fifteenth, which affords much profitable study; this has fine sculpture of beasts of the chase, from the adjacent ancient Wychwood Forest. Over the porch was a monks' room, approached from the north transept, with window opening into church. Beneath the great window in the north transept formerly existed a crypt or undercroft; immediately below this window are two fine traceried recesses, with recumbent effigies therein. At present they are, I believe, about 12 feet from the present level of transept floor; beneath may be seen the remains of the crypt with springers and windows, also a door on west side, now blocked up, which opened to the yard. The tombs are richly traceried, and decorated with ball-flower ornament in the hollows.

Similar undercrofts may be seen in other parts of the county, particularly one at St. John, Burford, where there is an undercroft below the south aisle which, I believe, formerly was used as a mortuary chapel. Here it forms a small gallery in the aisle, and makes a very interesting and picturesque feature.†

Three magnificent spires lie together, in the northern part of the county a little below Banbury. They

* I came across other instances of capless arcades at Cropredy, in the northern part of the county, and Cogges next Witney.

† There is a similar instance in Dorchester Abbey, Oxon.

are, commencing from the west, Bloxham, East Adderbury, and King's Sutton, the latter of which is just over the frontier, in the county of Northants. They have given rise to a local legend:—

"Bloxham for length,
Adderbury for strength,
King's Sutton for beauty."

Bloxham.—This is of the fourteenth century, with most glorious detail; the tower and spire, as are those of the other two, being placed at the west end of the church; the west doorway is in the tower. This is a most remarkable work. Birds and flowers are sculptured in the hollows, while over the label running up the arch is a series of niches stepped up, filled with sculpture in low relief; they contain figures of saints and angels. At the apex in a deeper recess, beneath a rich canopy is Our Lord in Majesty, with censing angels around him. On the south side, sculptured in the wall, is an elaborated representation of the resurrection of the just to life eternal; the saints are shown rising from their graves in the same way as at the portal in north transept of Rheims Cathedral and elsewhere. On the south side the wicked are represented as being devoured by the dragon. The belfry breaks into an octagon; the openings, which are three in number, have to my mind the appearance of weakness at this point, as they come to near the quoin. The tower finishes with a richly traceried parapet getting very close to Perpendicular, with pinnacles at angles of the octagon. From this the spire springs to a great height, and is crocketed a short distance up. The buttresses at base of tower are very good. The church, both internally and externally, is replete with everything which cannot fail to delight the seeker after beauty. Remains of fine colour decoration upon the screen, and big frescos, remain to tell something of the glories of this magnificent church in former days; the remains of sculpture and tracery add to the many riches. The nave arcade is thirteenth century, the columns on the south side being clustered with foliage introduced into angles; the arcade on the north side is cylindrical. On the south side are two fine Perpendicular chapels with good windows.

East Adderbury.—An adjoining parish, which has much in common with Bloxham. The church stands upon an eminence, picturesquely placed, with tower and spire at west end. This is not so elaborate as Bloxham, and is of rather earlier date. Tower buttressed at angles; pinnacles at broach; open parapet, with spire starting from within same. The church now is mainly Decorated, and has a fine arcade, thirteenth century, with a magnificent fourteenth-century roof over, flat pitched; the last three of the bays are cusped. Sir Gilbert Scott restored the rood-screen, which now is complete; above may be seen the stump of what must have been a rood-beam; this is on either side, and is cut off close to the wall. The chancel, with reredos and sedilia, and monks' rooms on north side, are all the work of William of Wykeham, the living belonging to New College, Oxford. The sculpture and windows here are exceedingly good. The reredos is divided into little canopied niches, with a large canopy on either side; the sedilia are very rich. The Priest's rooms on the north side are interesting, on the ground storey being a fine oriel window, fireplace, and staircase, leading to room above and the leads; in the window is an altar slab. Running round the aisles is a most remarkable cornice, filled with the most delightful sculpture of men and beasts and "what nots," doing the most eccentric and ludicrous things, most with elaborate tails foliated; some are playing wind and other instruments. Subjects of two of these: Man stroking an ass, A dog licking his own ear, &c. The rood stairs in most churches I saw were singularly dangerous and inconvenient, to say nothing of necessary head room; the treads often are less than half the rise of the steps, which without exception was very steep, and in many instances not uniform; the stairs, I observed, seemed generally to commence about five feet above level of aisle floor. Both here and at Bloxham there must have existed western galleries, for the doors from the western tower remain, although they have been blocked up. Before leaving this, let me note that similar sculptured cornices exist at Bloxham, to north aisle, and to Hanwell chancel, in the northern part of the county.

King's Sutton.—The last of these three remarkable churches is King's Sutton, a few miles east of Adderbury, in county Northants. As seen from the railway, little could surpass its simple majesty. Like Bloxham and Adderbury, it also is at the west end of its church. The tower and spire are of fifteenth-century date, early in the style. The tower tapers towards the spire; the belfry has two openings on either side, pointed arches traceried, but both under one flat label. The parapet is traceried with gargoyles at angles, from within, which rise double pinnacles, both connected with spire by little flying buttresses. The spire light is placed some little way up the spire, and is richly traceried. The spire is crocketed all the way up, and is divided by one band of sculpture, and opening near the summit. The church possesses much of interest; there is a remarkably fine Perpendicular porch to the tower. There is a curious feature in the north arcade of nave, which is Transitional; one of the capitals seems to have failed in the fifteenth century, and a Perpendicular one has been inserted, with a stamp of its own individuality on it.

Bampton-in-the-Bush.—Another imortant spired church is that of St. Mary, Bampton-in-the-Bush. Here again, as at Witney, the tower and spire are placed over the crossing. The tower tapers ; has very small belfry opening, and is finished with a flat traceried parapet. The pinnacles are very cleverly and picturesquely designed in the form of a group of clustered columns. On the capitals are placed figures, connected with the main structure of the spire by a bar of stone. The spire light is simple, and a well contrived square staircase gives access to the north transept. The church is entered from the west by a remarkable Decorated porch formed beneath the west window ; it is a low gable arched out ; the doors within have good ironwork of ancient date. Within the church at this point one is immediately struck with the proportion of the nave arcade, which is very fine, and of Decorated date ; the bases are pedestaled up, and to my mind the success of this nave is owing to the absence of clerestory. The windows are triplets with cinqfoiled arches on the inside; several of the porches have also trefoiled heads. On the south side, leading to the transept door (which is Norman), is the ancient paved path channelled. The ancient boundary wall exists, and in the churchyard may still be seen some of the old tombs of thirteenth and fourteenth century; some with effigies thereon,—happy still in escaping the ravages of the Vandal. The heads of some of the windows on south side of chancel are treated in sunk tracery.

Burford.—Another commanding and larger church is that of St. John Baptist, Burford, the plan of which is most irregular at one point, there being as many as five aisles. The tower, placed in the crossing, is of Norman foundation, and from its internal western face much can be learnt of the earlier roof history of the nave. The belfry, with parapet and spire, a late fourteenth-century addition, seems to have crushed the tower. In the fifteenth century the north and south arches of tower were partially arched in. The lower part of the tower is rich Norman, with elaborate windows at ringing chamber level. Internally a triforium gallery runs round tower. There is a similar triforium in Witney Church. Circular moulded arches opening east and west into the church, with the greatest attainable span. On the north side may be seen a respond of the ancient Norman nave, which was replaced in the fifteenth century by the present magnificent Perpendicular arcade, the sculptured bosses of which are peculiarly interesting. The church is of such vast extent that many altars seem to have been in use, and increasing congregations in the fifteenth century, when the new nave arcade was inserted, probably gave rise to the erection of the most unique chapel I have ever seen. It is placed beneath the easternmost arch of nave on the north side, abutting upon the western respond of the tower. The sketch and plan [Illustn. xlix.] of this edifice will give some idea of the arrangement. The chapel is screened round, and is covered by a traceried tester. The altar is of stone, as also is the dossel, which is made to cove in a singular way; this is vaulted. The whole has been beautifully restored by Mr. Street, and decorated in colour, part of the drawing being set out by himself on the spot. The levels of the church are somewhat puzzling : the whole church, from the nave door to the chancel end, being on one level. The font, which is at west end of north aisle, has sedilia about 9 inches above floor level, so that the church at this may have been about 18 inches lower than at present.

Stanton Harcourt.—The gateway of the Manor House remains with the surrounding wall ; there is a good square battlemented Perpendicular tower, on the ground floor of which is the domestic chapel. Close adjoining is the great kitchen, which is a separate building. It is square, and has an octagonal roof, which is 25 feet high, and 35 feet springing of roof to floor. There are fireplaces, but most of the cooking was done with "dogs" on the floor, the smoke and steam finding its way out through louvres. The roof is reached by a newell staircase. The roof is fine open timbered construction, though now much blackened by smoke. Views of the interior and exterior are here given [Illustns. xlvii., xlviii.] ; the interior view is very fine. The roof is surmounted by a fine griffin, 8 feet high, bearing the Harcourt Arms.

WILLIAM ALFRED PITE.

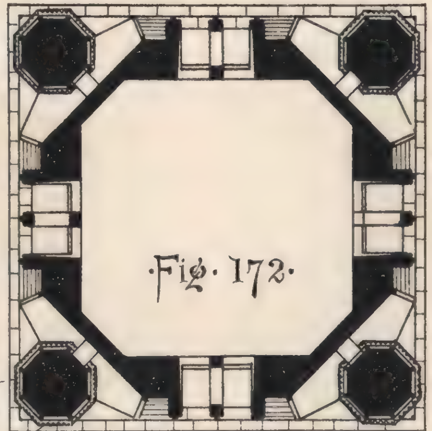
XX. THE INSTITUTE SILVER MEDAL AND TEN GUINEAS FOR MEASURED DRAWINGS: ELGIN CATHEDRAL, SCOTLAND.

By A. W. Anderson, *Associate.*

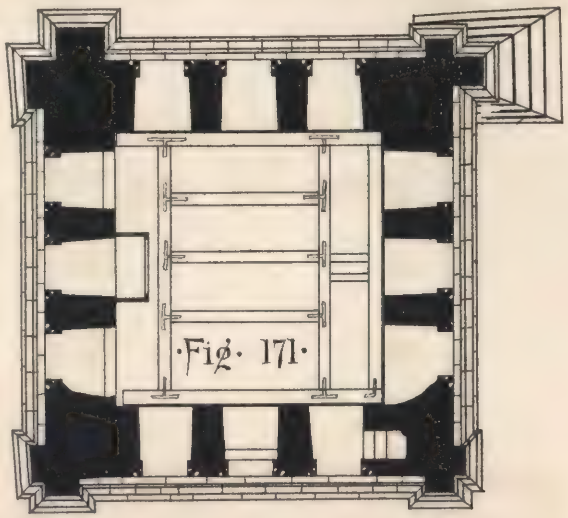
[Illustns. l.-lv., figs. 190-247.]

Dryden Press : J. Davy & Sons, 137, Long Acre, London.

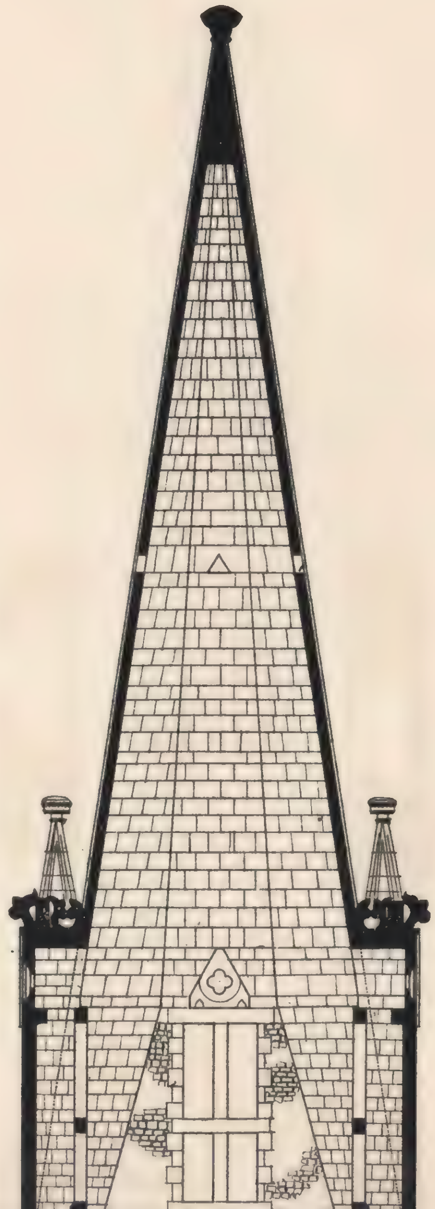
XIX. THE PUGIN TRAVELLING STUDENTSHIP:_TOUR IN OXFORDSHIRE. (xlv.)

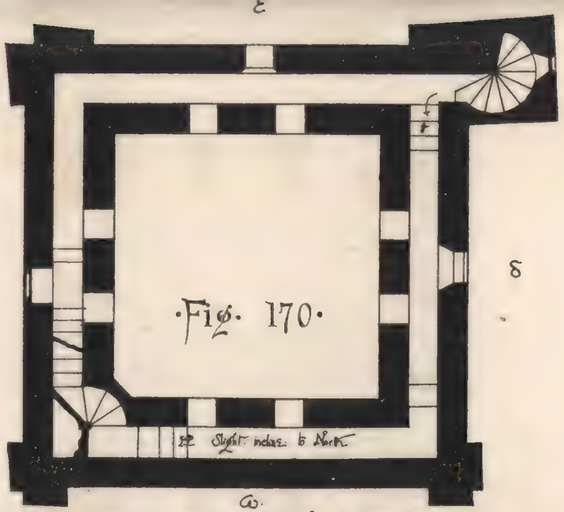


· Plan thro Spire at A ·



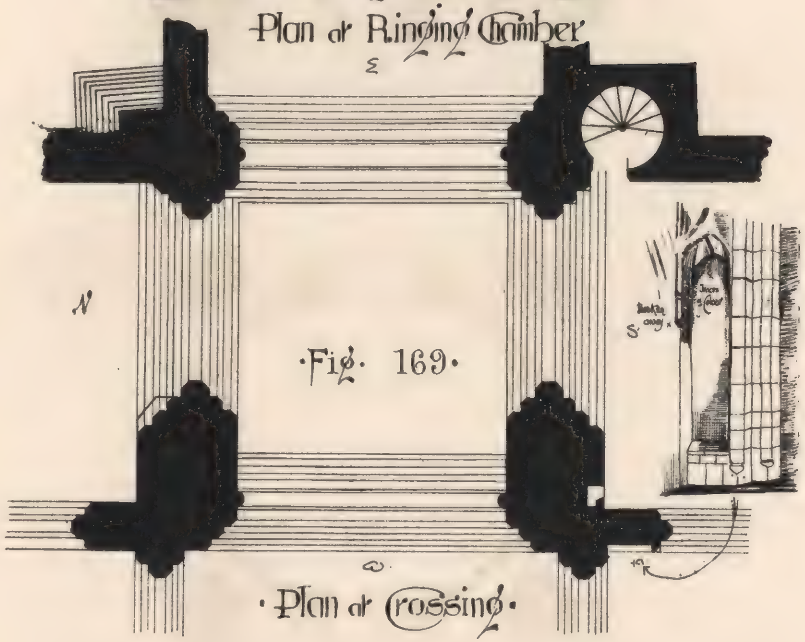
Plan [illegible] Belfry





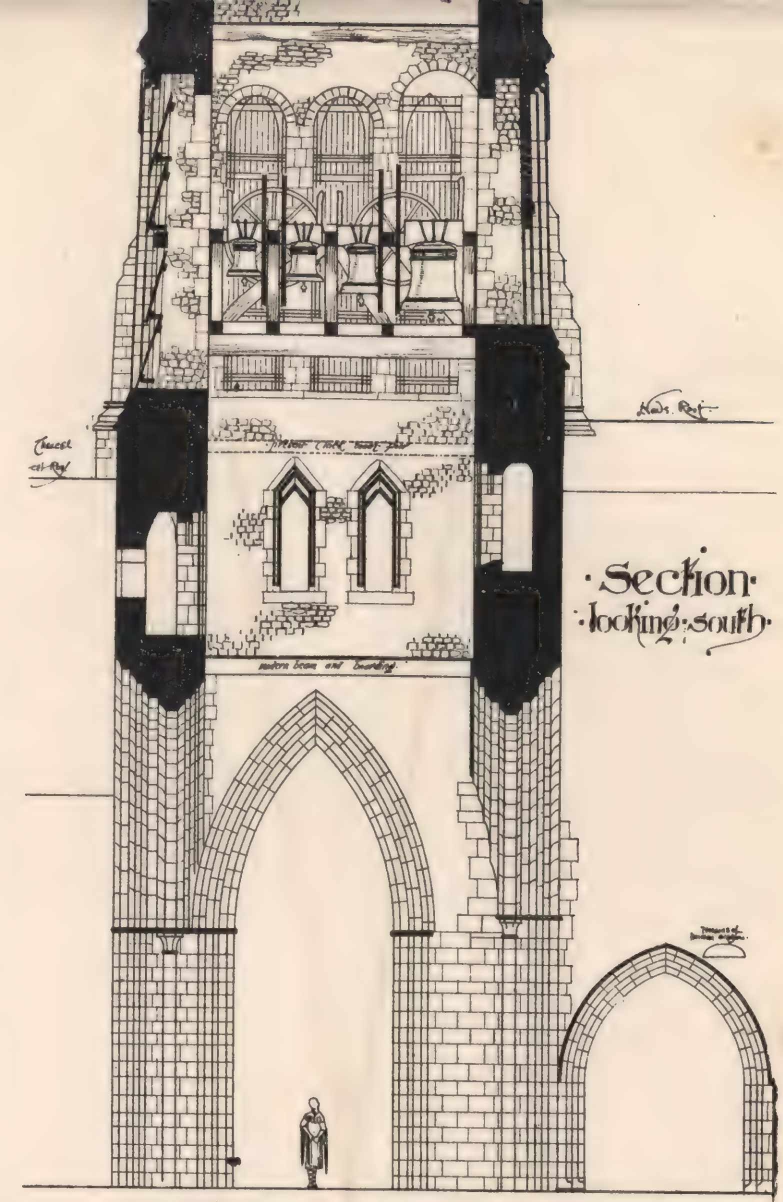
·Fig· 170·

Plan at Ringing Chamber



·Fig· 169·

·Plan at Crossing·



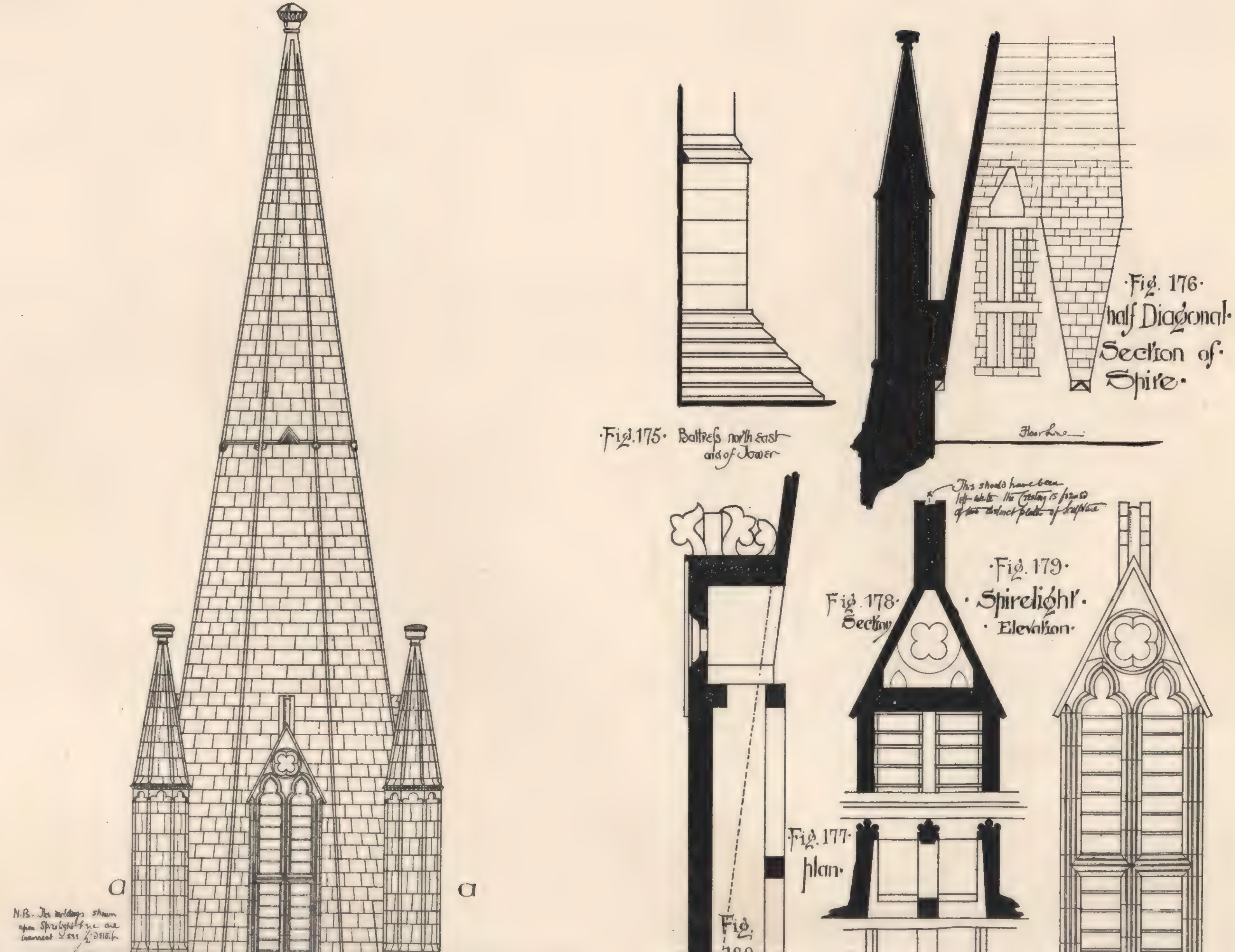
·Fig· 173· Section· ·Bay of Nave·

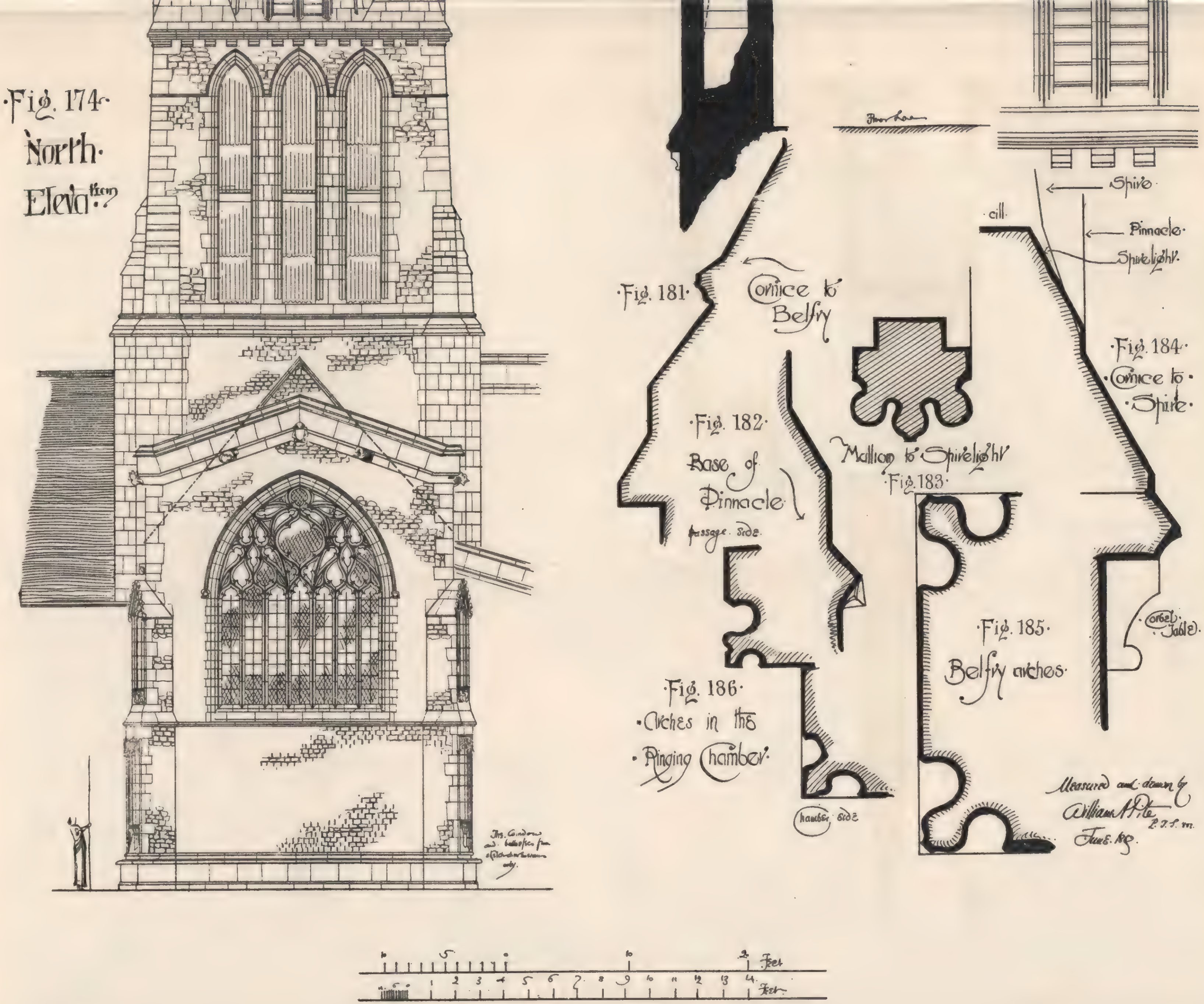
W. A. Pite del.

C. F. Kell, Photo-Litho. Castle St Holborn, London, E.C.

THE TOWER AND SPIRE OF ST MARY, WITNEY.

XIX. THE PUGIN TRAVELLING STUDENTSHIP:_TOUR IN OXFORDSHIRE. (XVI.)





W.A.Pite del.

THE TOWER AND SPIRE OF ST MARY, WITNEY.

C.F.Kell, Photo-Litho. Castle St Holborn, London, E.C.

XIX. THE PUGIN TRAVELLING STUDENTSHIP: TOUR IN OXFORDSHIRE. (xlvii)

W. A. Pite del.

C. F. Kell, Photo-Litho. Castle St Holborn, London, E.C.

FIG. 187. THE ABBOT'S KITCHEN, STANTON-HARCOURT.

XIX. THE PUGIN TRAVELLING STUDENTSHIP:_TOUR IN OXFORDSHIRE. (xlviii)

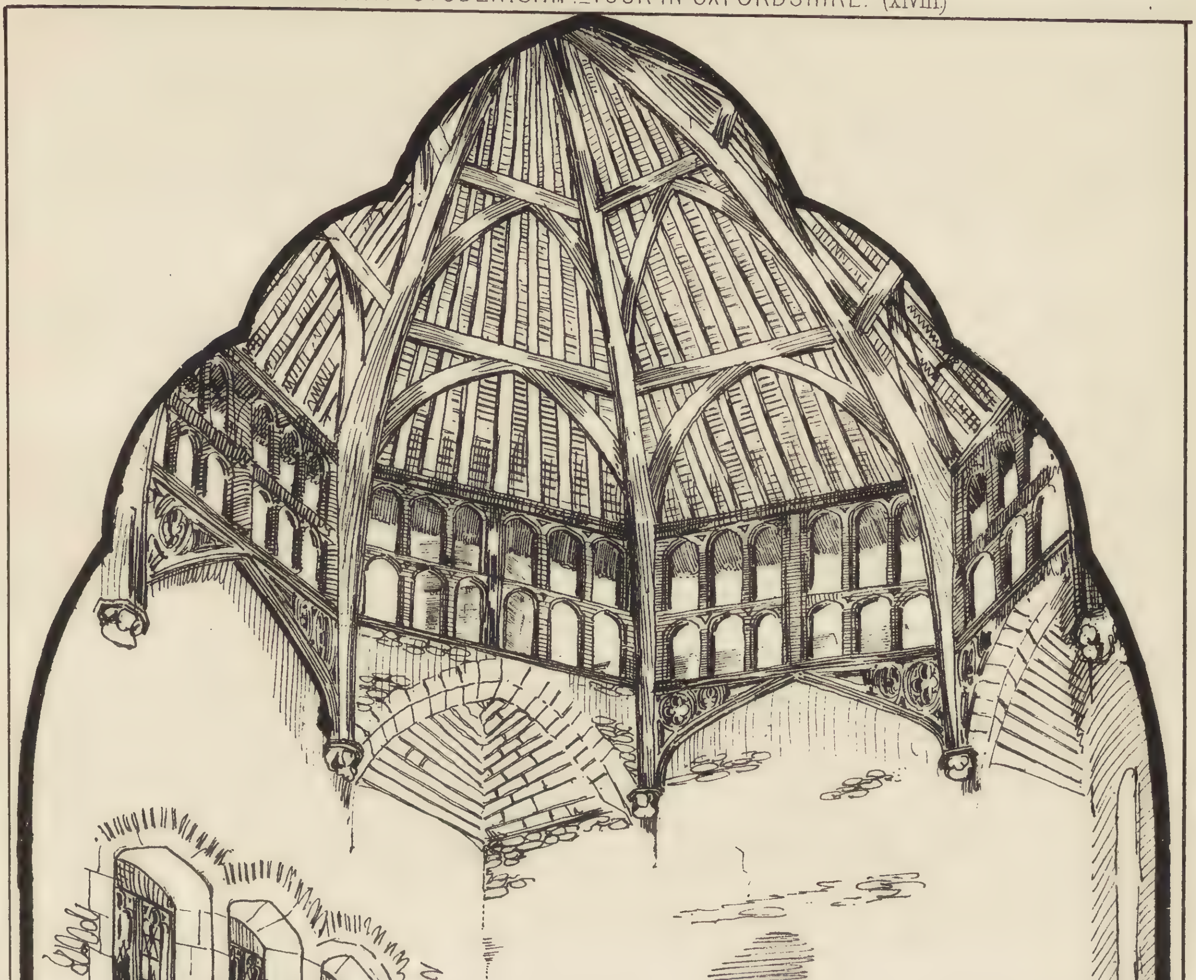
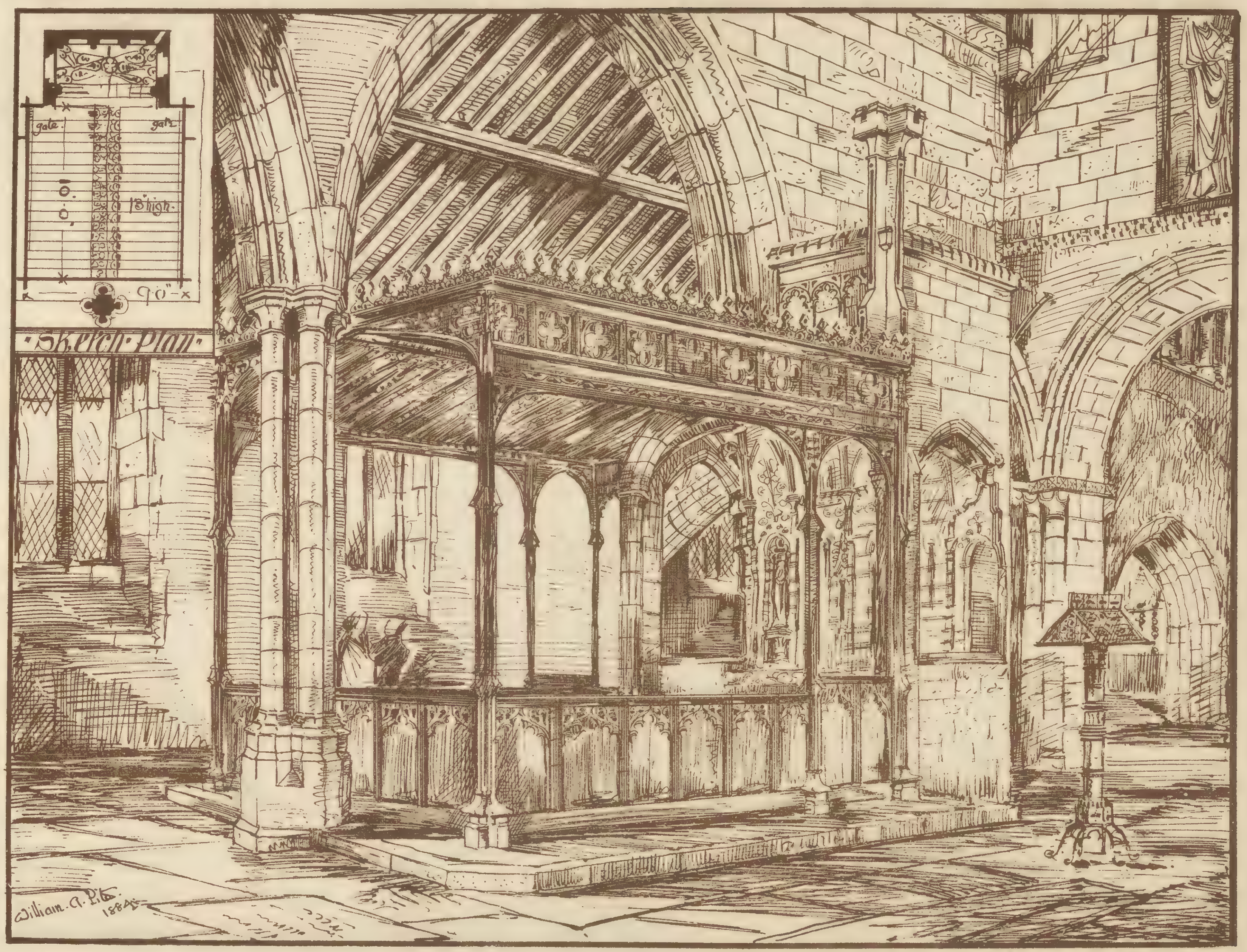


FIG. 188. INTERIOR OF THE ABBOT'S KITCHEN, STANTON - HARCOURT.

W.A. Pite del.

C.F. Kell, Photo-Litho. Castle S^t Holborn, London, E.C.

XIX. THE PUGIN TRAVELLING STUDENTSHIP:_TOUR IN OXFORDSHIRE. (xlix.)



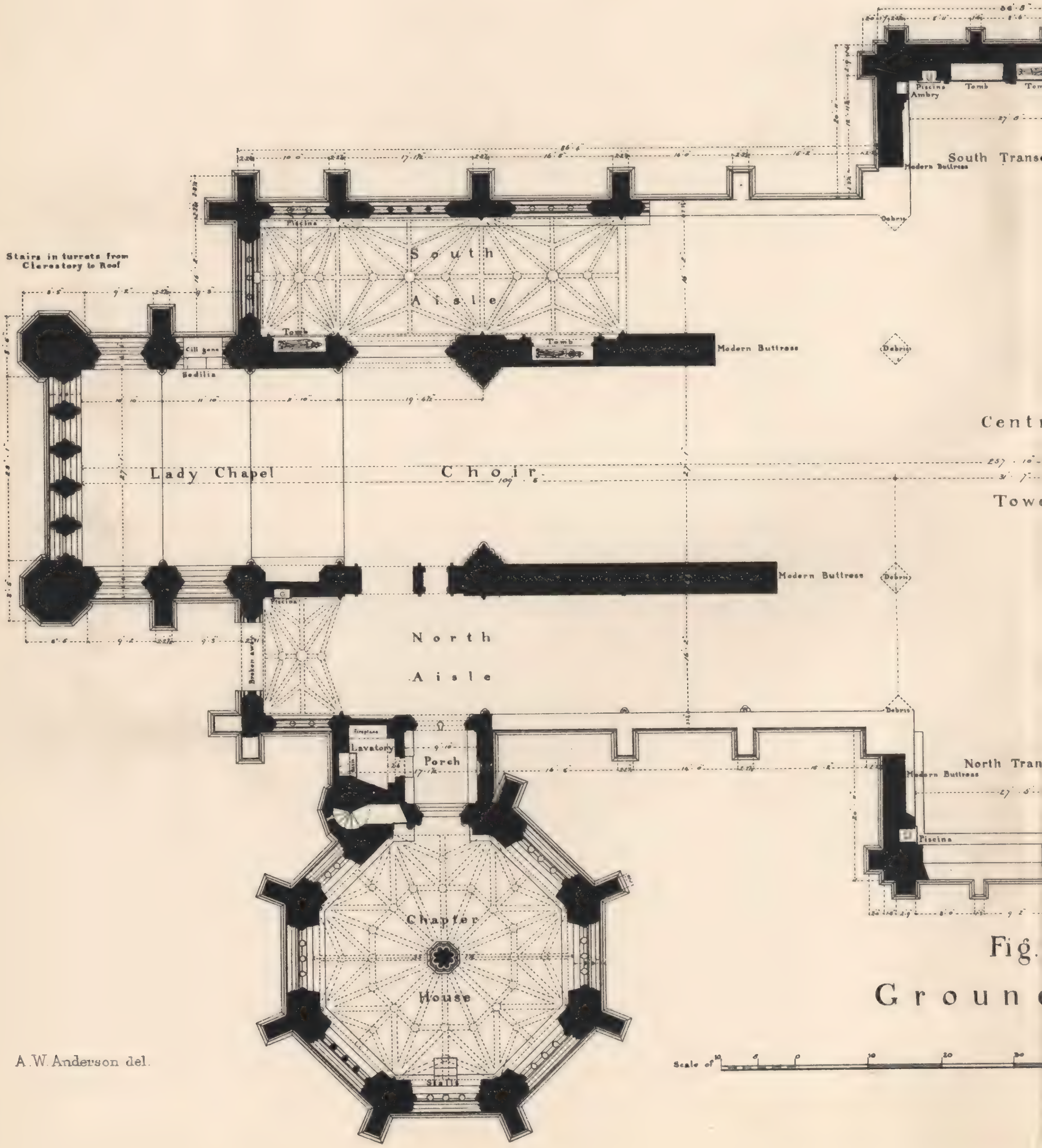
W. A. Pite del.

FIG. 189. CHAPEL IN ST JOHN BAPTIST, BURFORD.

C F Kell Photo-Lith & Printer, 8 Castle St Holborn London E C

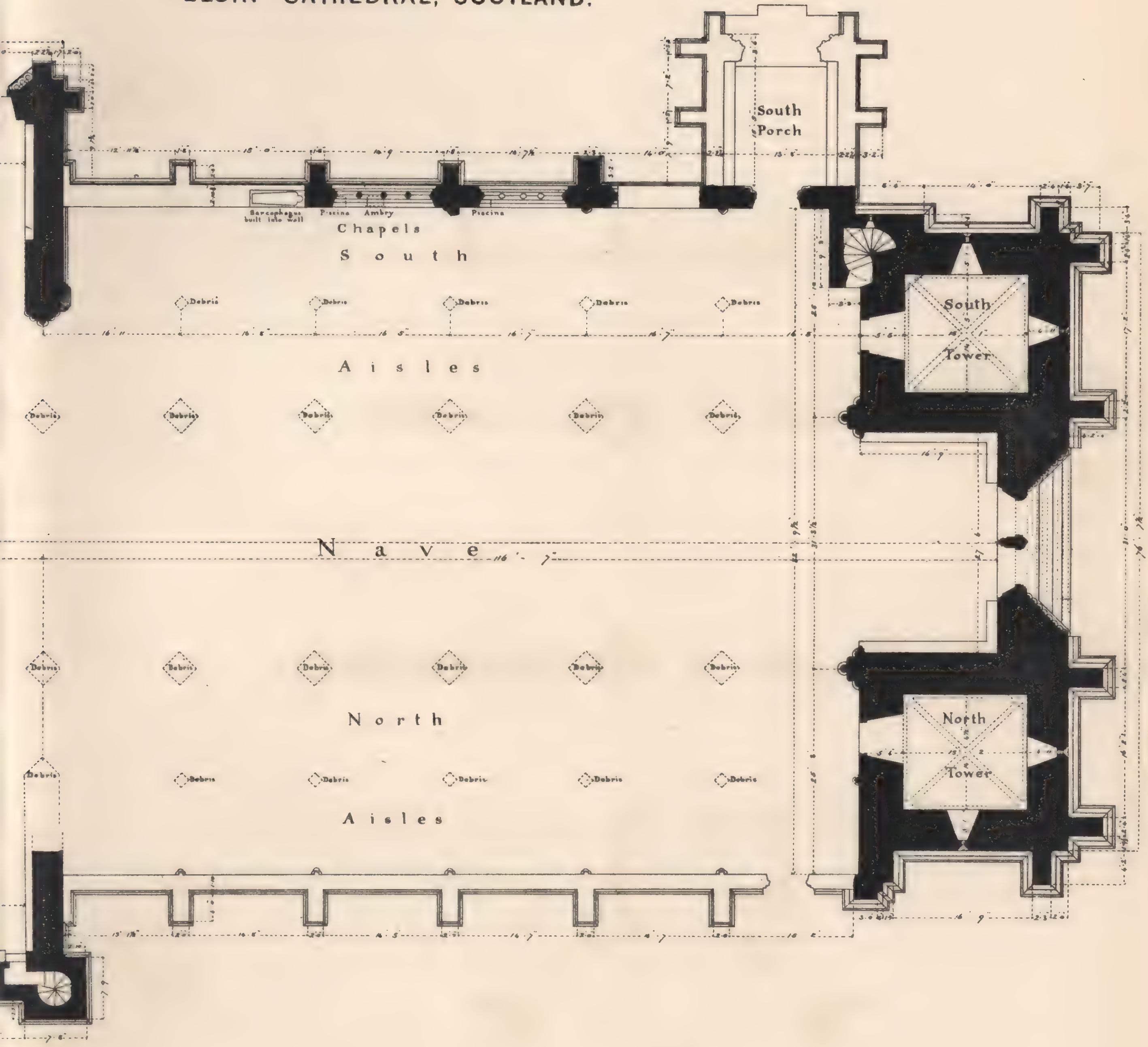
TRANSACTIONS OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS, 1883-84

XX. THE INSTITUTE SILVER MEDAL AND TEN GUINEAS FOR MEASURED DRAWINGS. (I).



A. W. Anderson del.

ELGIN CATHEDRAL, SCOTLAND.



Note.
Walls untinted on Plan are broken down to base level

Plan.

Feet

C. F. Kell, Photo-Litho. Castle St Holborn, London, E.C.

XX. THE INSTITUTE SILVER

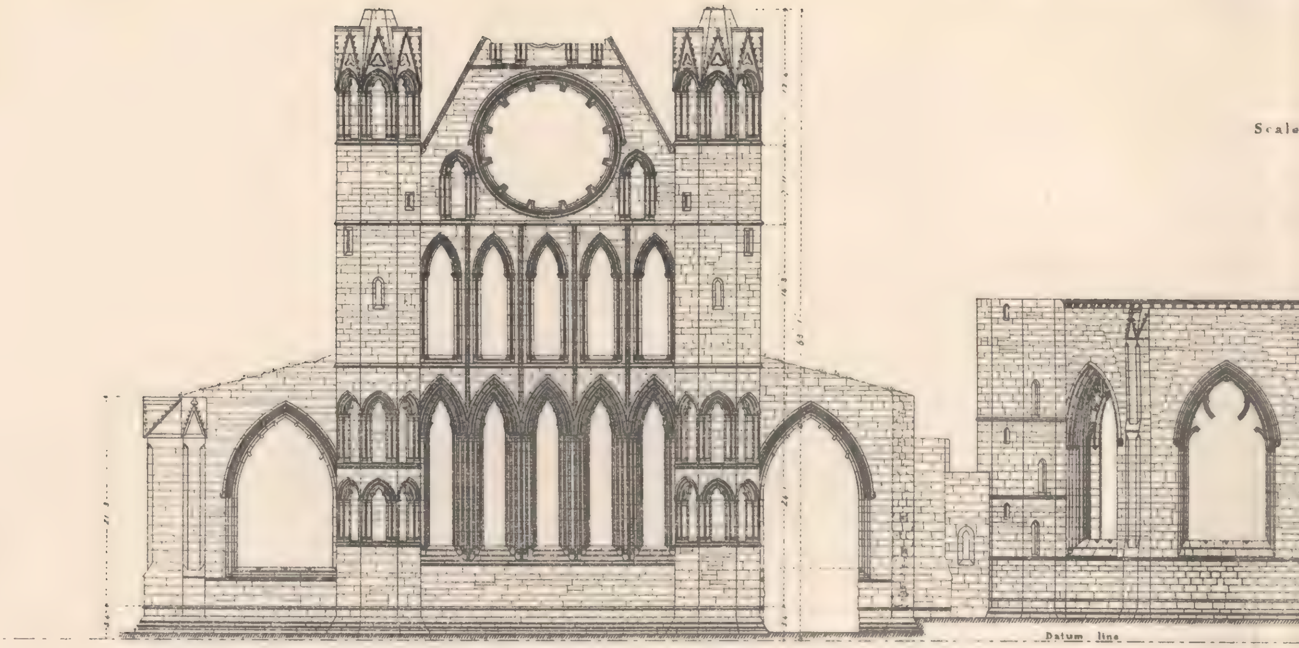


Fig. 191 East Elevation

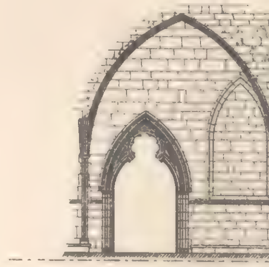
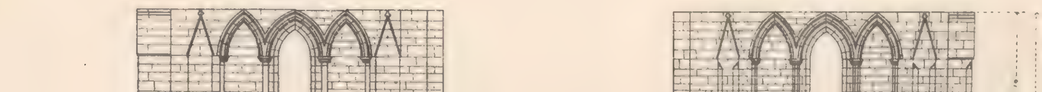


Fig. 19
Section through North
(looking N



A.W.Anderson, del

Fig. 192. West Elevation.

BRITISH ARCHITECTS. 1883-84

EDAL AND TEN GUINEAS FOR MEASURED DRAWINGS. (li).

ELGIN CATHEDRAL, SCOTLAND.

Fig. 193.
Section through South Aisle of Choir
(looking North)

e of Choir

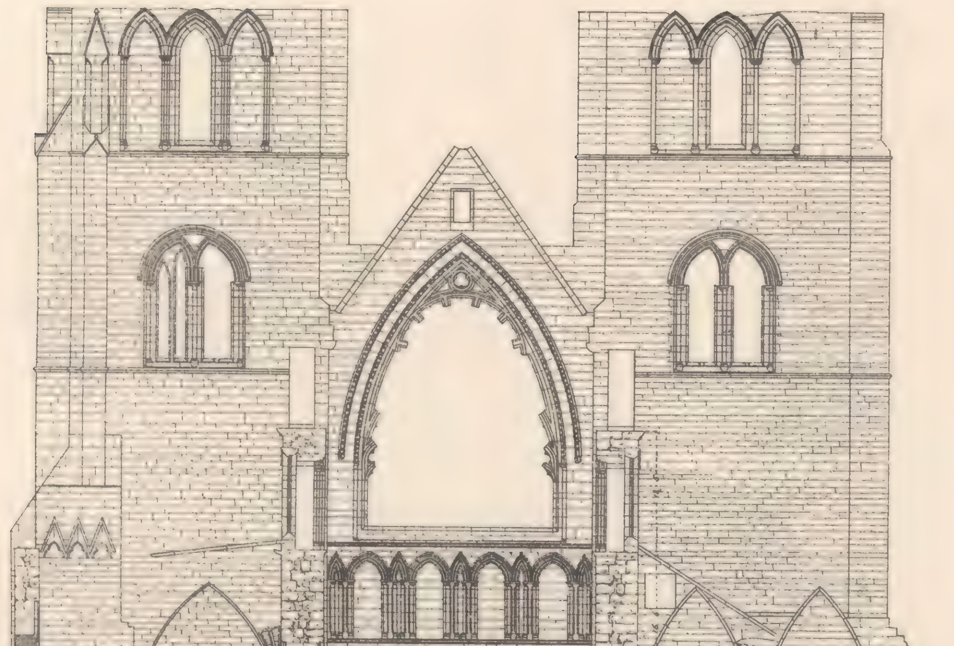


Fig. 195. Section through Nave (looking West)

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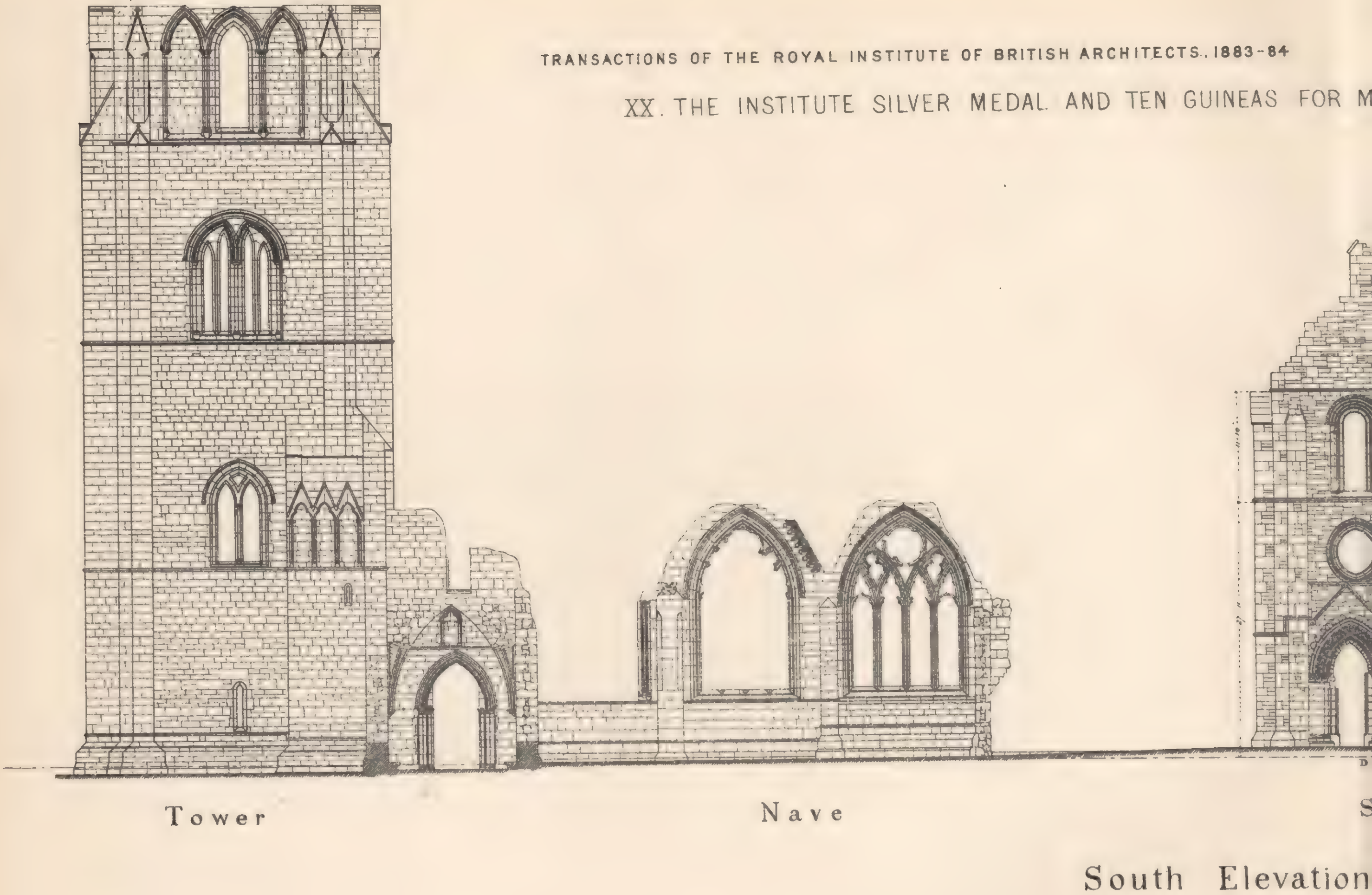
XX. THE INSTITUTE SILVER MEDAL AND TEN GUINEAS FOR M



South Elevation
Fig. 1

Scale of

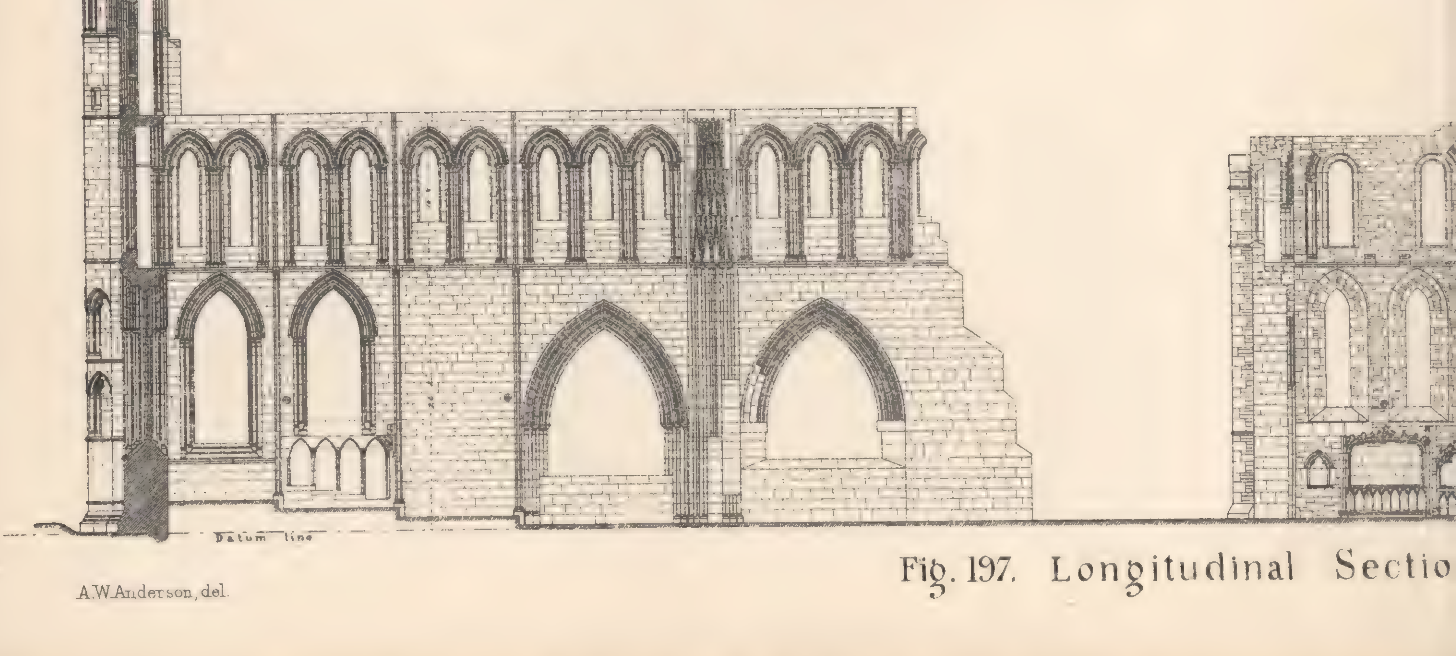


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Fig. 197. Longitudinal Sectio

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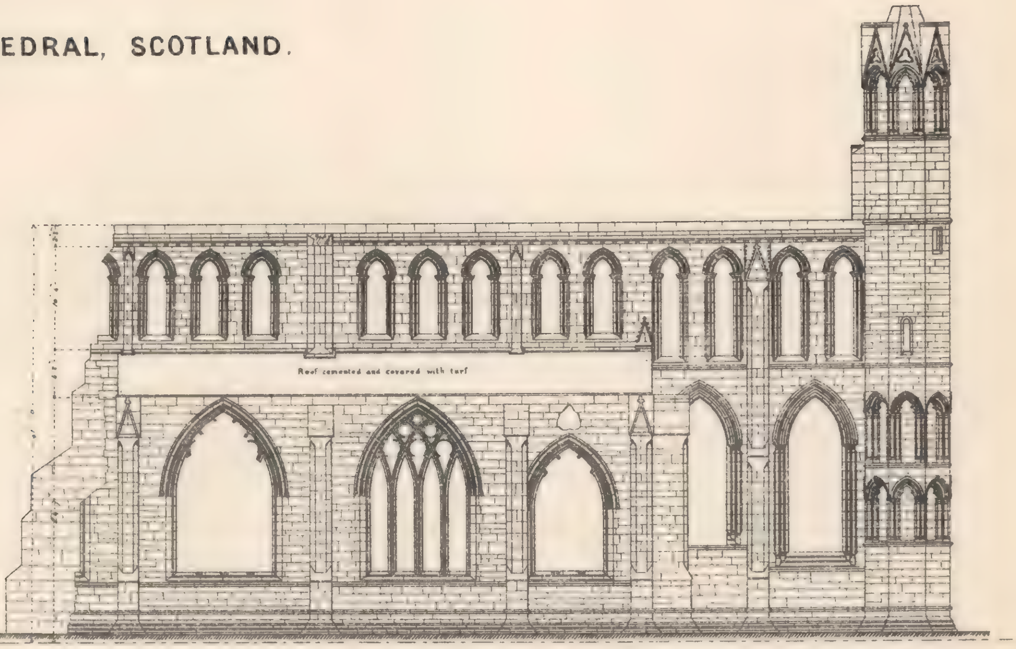
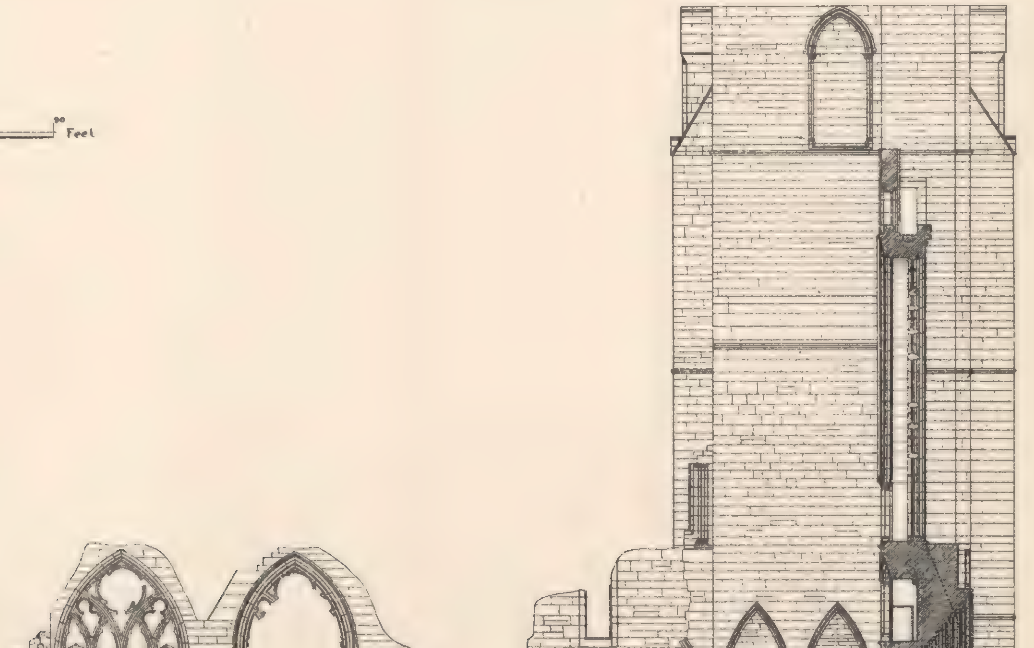


ransept

Choir

f Cathedral



ooking South

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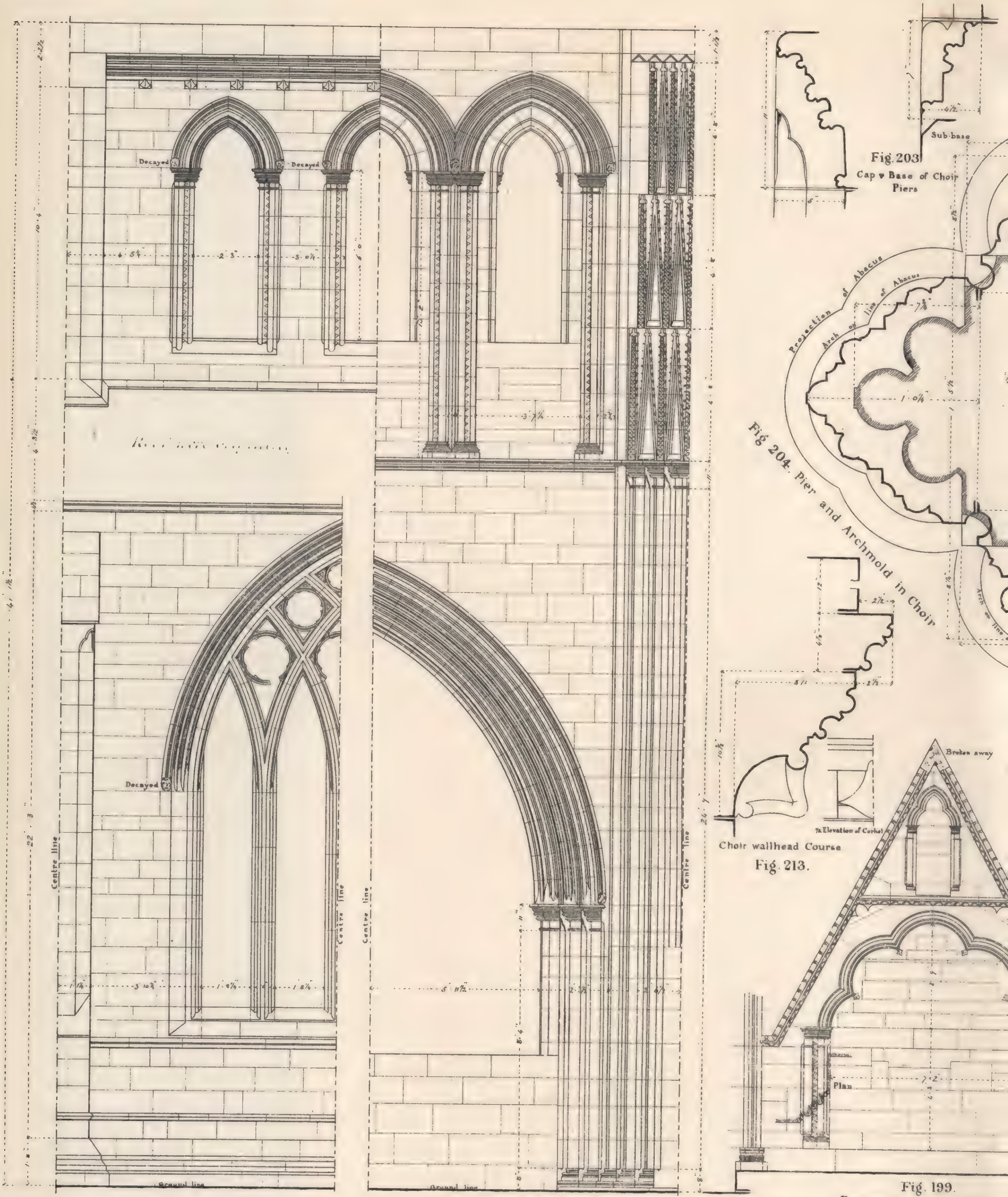

Half Exterior Fig. 198. Half Interior

Fourth Bay from E. S. side of Choir

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XX. THE INSTITUTE SILVER MEDAL AND TEN GUINEAS FOR MEASURED DRAWINGS

ELGIN CATHEDRAL, SCOTLAND.

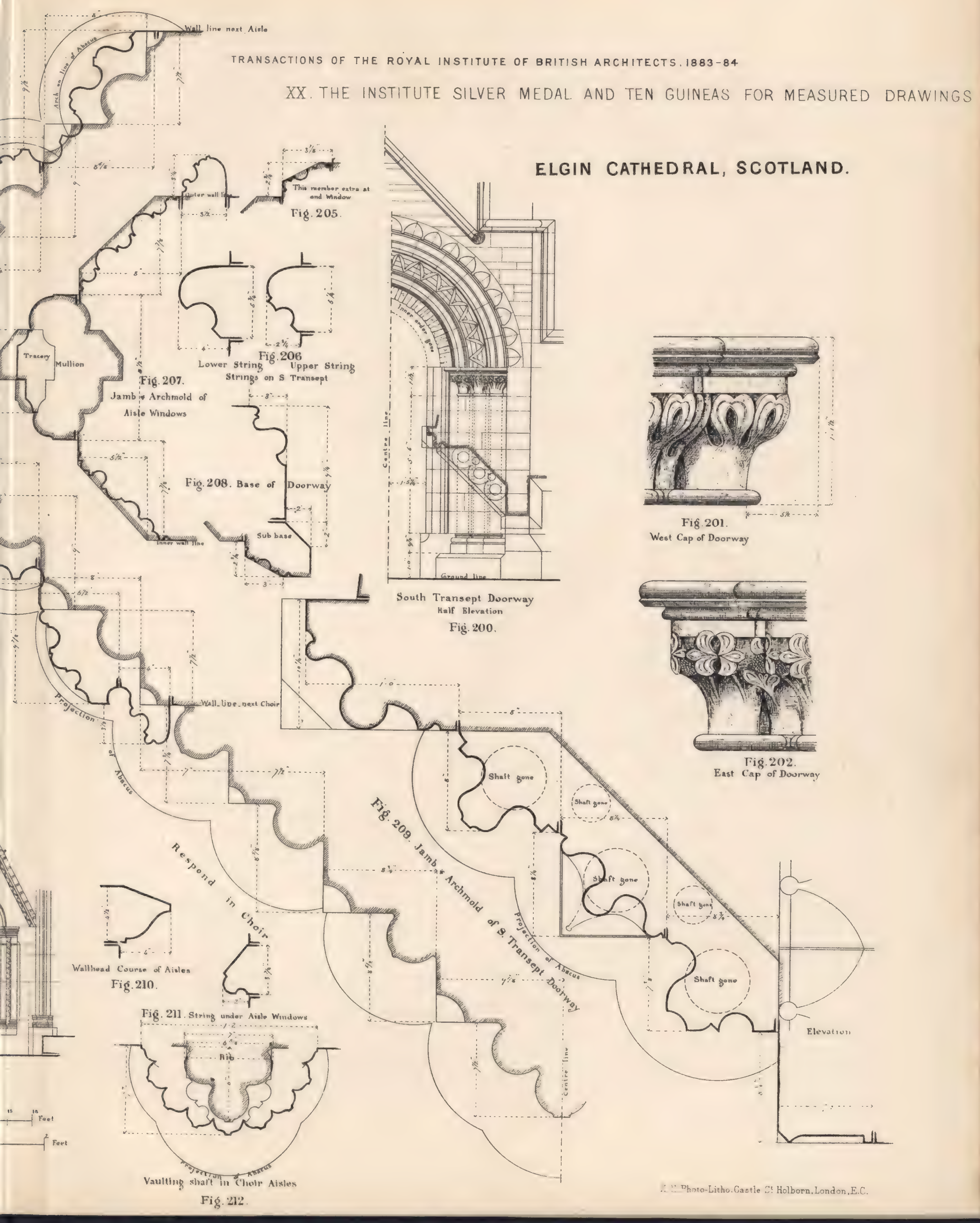

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Fig. 217.

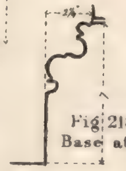


Fig. 218.
Base at B.

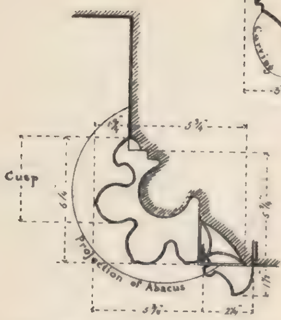


Fig. 216. Jamb and Archmold of Niche at side of Doorway

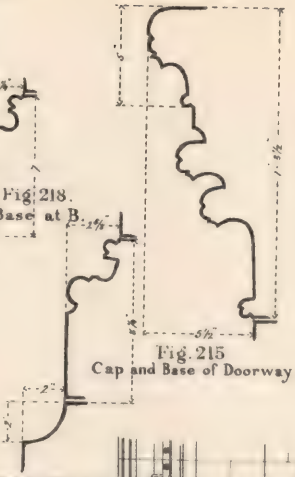


Fig. 215
Cap and Base of Doorway

Fig. 231. Respond of Nave Pier at Tower

Fig. 214. Jamb and Archmold of West Doorway

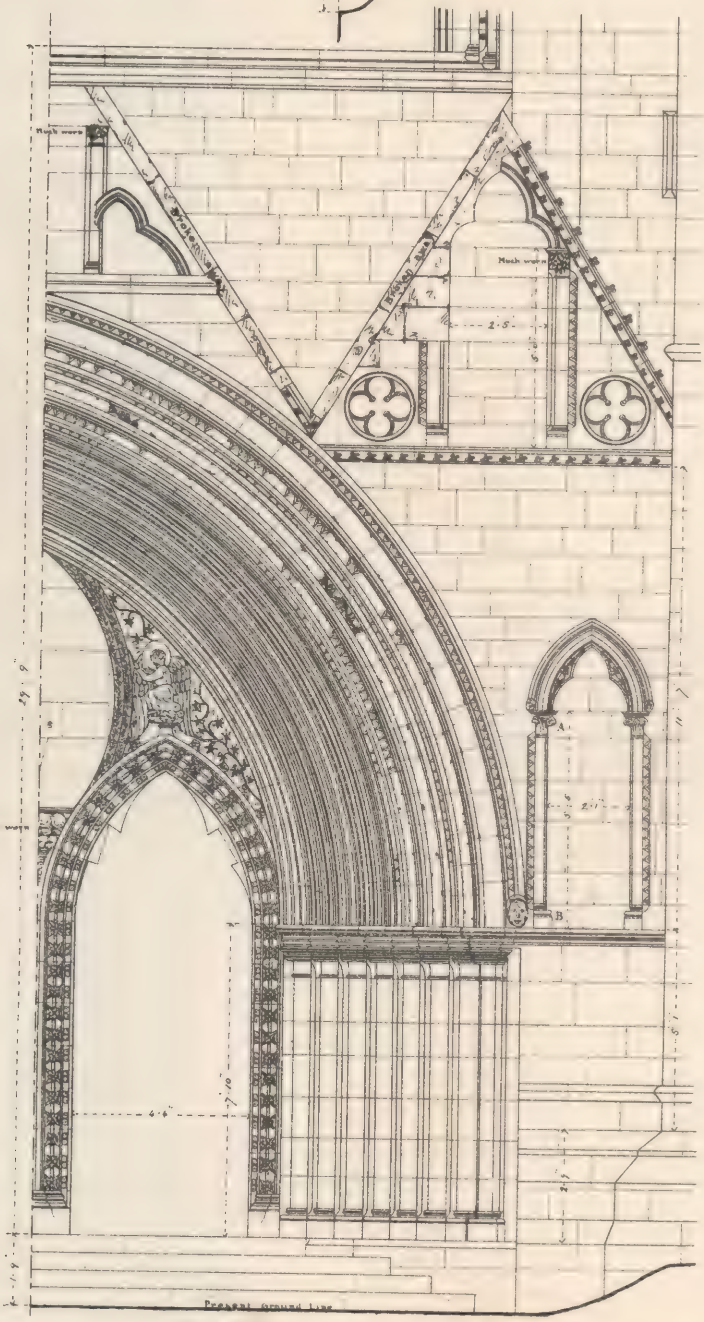


Fig 213.
Western Doorway
Half Exterior

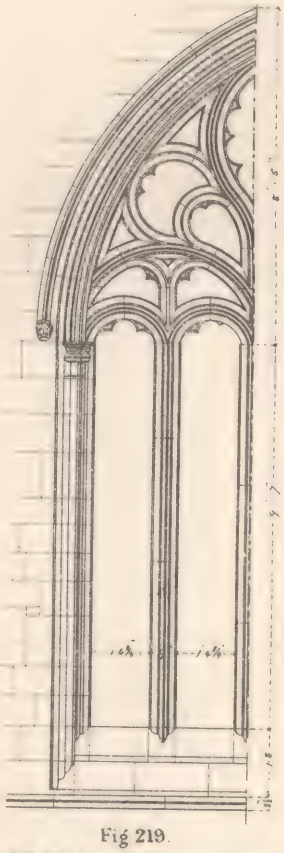
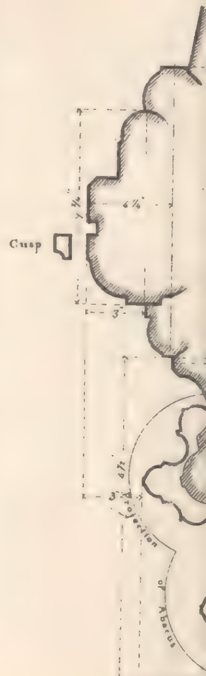


Fig 219.
N.E. Window of Chapter House
Half Exterior



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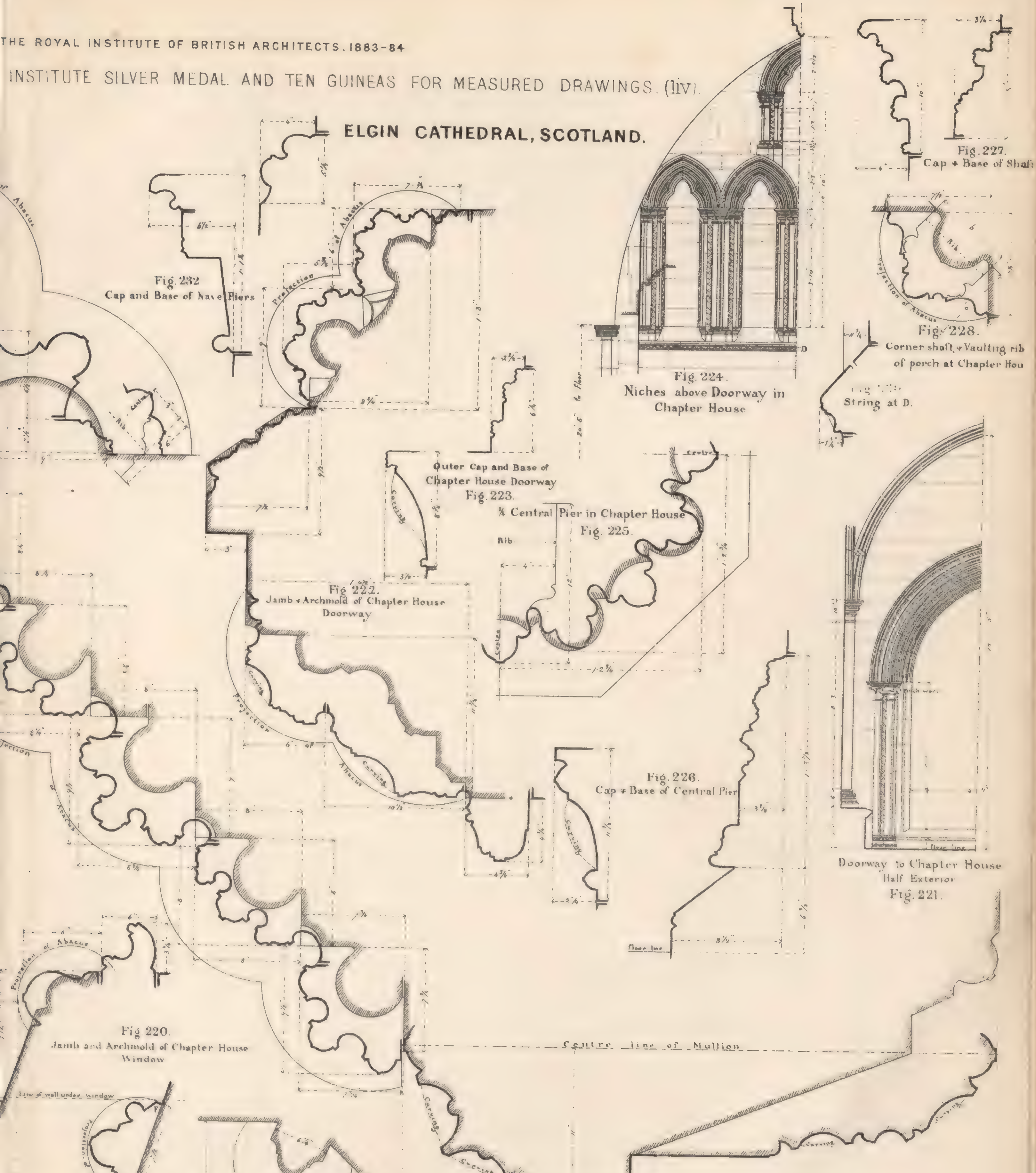

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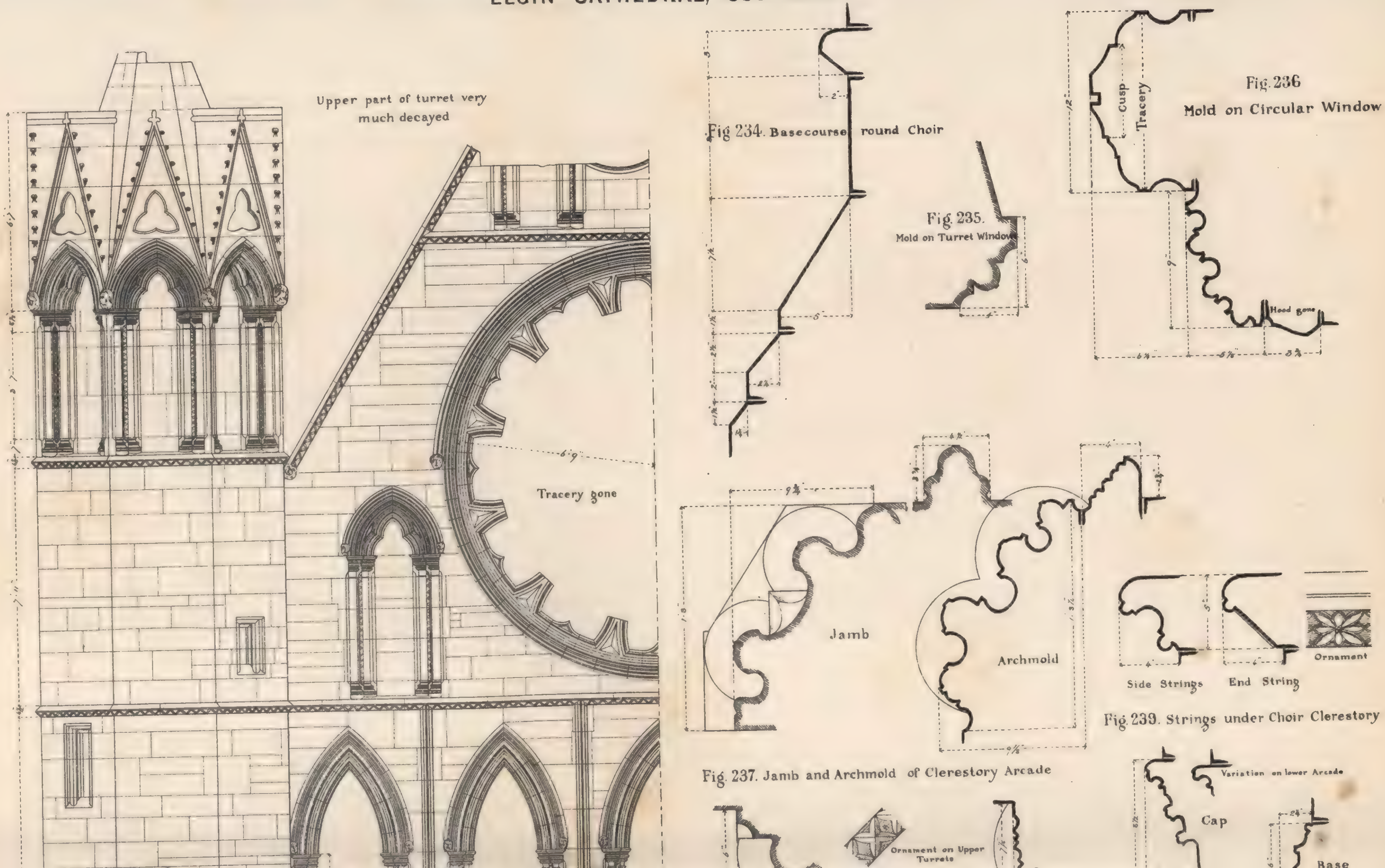

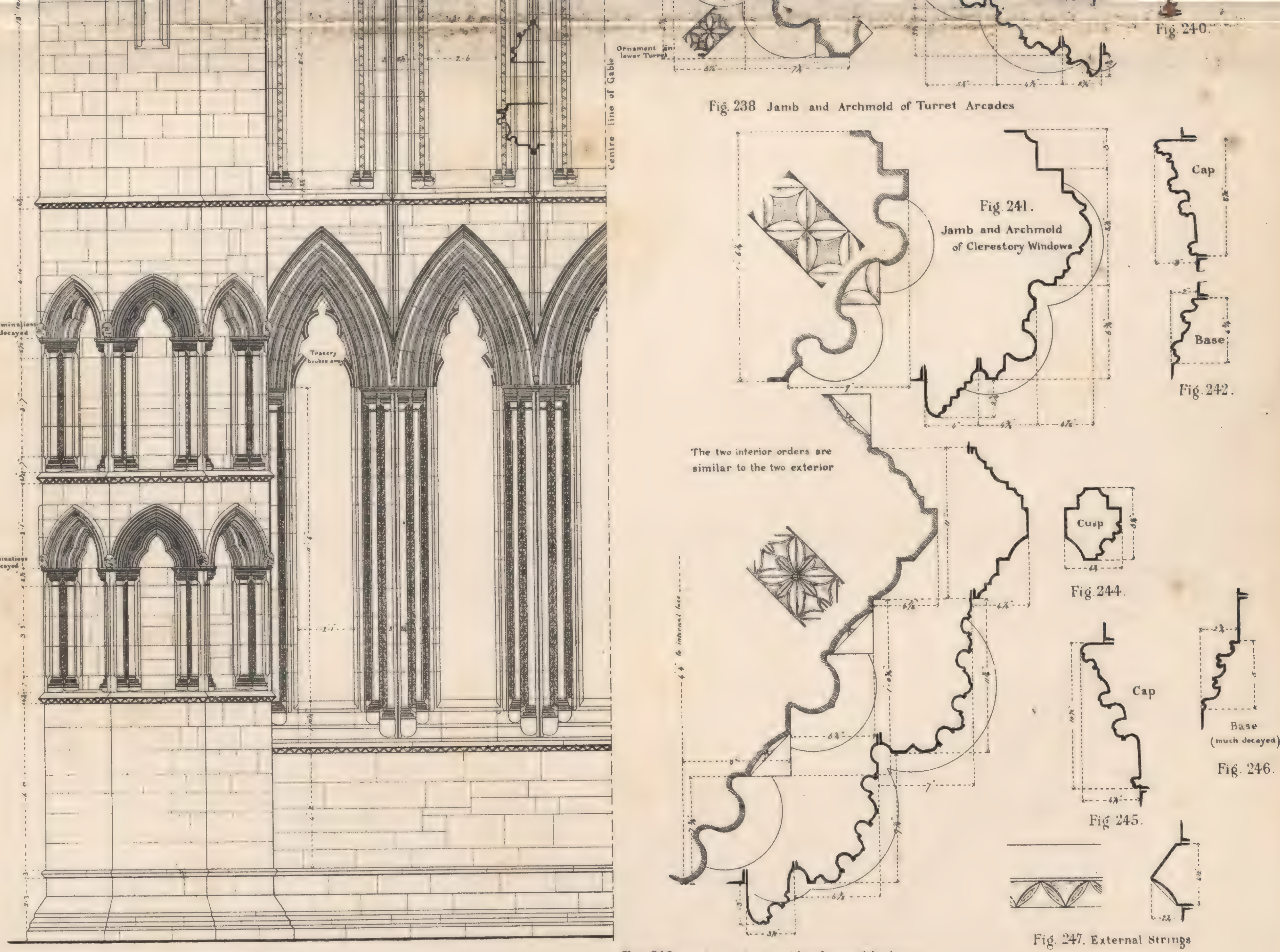

Fig. 240.

Fig. 238 Jamb and Archmold of Turret Arcades

Fig. 241. Jamb and Archmold of Clerestory Windows

Fig. 242.

Fig. 244.

Fig. 245.

Fig. 246.

Fig. 247. External Strings

Fig. 243. Jamb and Archmold of Lower Windows

Fig. 233. Half Exterior Elevation of East End

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